SERIES 3, Vol. 24, No. 3

MARCH, 1941

AMERICAN JOURNAL OF OPHTHALMOLOGY

CONTENTS

		Page
Spherophakia with glaucoma and brachydactyly	*S. J. Meyer and T. Holstein*	247
Ocular involvement in vaccinia	*A. O. Pfingst*	257
Protein content of re-formed aqueous in man	*P. C. Kronfeld, C. K. Lin, and T. H. Luo*	264
Function and structure of the eye	*E. Jackson*	277
Benzedrine and paredrine in homatropine cycloplegia	*W. F. Moncreiff and K. J. Scheribel*	282
Illumination standardization of the Snellen chart	*H. G. Martin*	287
Local use of sulfanilamide compounds in the eye	*J. S. Guyton*	292
Operation for entropion due to trachoma	*J. S. Maxwell*	298
Extrafoveal visual acuity measured with Snellen letters	*E. Ludvigh*	303
Droughts and development of senile cataract	*P. W. Salit*	310
Local treatment of gonorrheal conjunctivitis	*P. Panneton*	314
A corneoconjunctival knife and counterpresser	*W. D. Gill*	322
Weve diathermy electrode. A new modification	*R. O. Rychener*	322
Transient myopia during sulfanilamide therapy	*D. P. Hornbogen*	323

DEPARTMENTS

Society Proceedings	325
Editorials	337
Book Notice	341
Special Notice	342
Abstracts	343
News Items	363

For complete table of contents see advertising page V

Subscription price in United States ten dollars yearly. In Canada and foreign countries twelve Dollars. Published monthly by the George Banta Publishing Company, 450 Ahnaip Street, Menasha, Wisconsin, for the Ophthalmic Publishing Company. Subscription and Editorial Office: 837 Carew Tower, Cincinnati, Ohio. Entered as second class matter at the post office at Menasha, Wisconsin.

AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 24 MARCH, 1941 NUMBER 3

SPHEROPHAKIA WITH GLAUCOMA AND BRACHYDACTYLY

SAMUEL J. MEYER, M.D., AND THEODORE HOLSTEIN, M.D.
Chicago

Numerous reports have been published of arachnodactylia associated with ectopia lentis, as first described by Marfan. The question as to whether there is a relationship between lens anomalies and muscular-skeletal changes is still debatable. We are able to demonstrate in another form of lens anomaly—namely, microphakia—that in other parts of the body similar changes occur that are significant enough to reveal a definite relationship between lens and constitutional anomalies.

Microphakia or spherophakia as reported in the literature and as observed by us appears to be rarely encountered, and certainly is of less frequent occurrence than congenital ectopia lentis. It is probably not correctly recognized, because such lenses frequently become subluxated and are then confused with dislocated lenses of other origin.

In previous observations of microphakia it has been noted that the lens was so small that its peripheral border was visible in its entire circumference when the pupil was dilated and the sagittal diameter was enlarged, giving it a bullet-shaped form. The result is a high myopia, loss of accommodation, increase in tension, and dislocation of the lens. The condition is congenital and hereditary.

Practically all the cases reported have been found only in the foreign literature, and we are presenting the following cases as the first to be reported in America.

CASE REPORTS

Case 1. Miss M. A. B., aged 17 years, white, was referred to the service of the senior author at the Illinois Eye and Ear Infirmary on November 24, 1939, because of poor vision. Vision in the right eye had been very poor for the past four years following an acute attack of bilateral severe ocular pain, headache, vomiting, and fogging of vision in both eyes accompanied by rainbow halos. Vision in the left eye cleared following subsidence of the attack, but in the right eye remained poor.

The medical history was essentially negative except for the usual childhood diseases.

The patient saw satisfactorily until she was nine years old, when she was given −7.00 D.sph. lenses in each eye for myopia. At the time of entrance to the hospital, the strength of the lenses had been increased to −17.00 D.sph., O.U.

The patient had not increased in stature for the past four or five years. Her parents enjoy normal vision and good health, and are first cousins. The mother is 4 ft. 10½ inches, and the father 5 ft. 4½ inches in height.

Two sisters and one brother who also have spherophakia are included as subjects of this report. Two other brothers have normal vision and are of average height.

Ophthalmological examination: Vision

in the right eye was light projection from the temporal side only; in the left eye it was 4/200 without glasses, improved to 20/65 with—17.00 D.sph. The palpebral fissures were small but well proportioned, measuring 10 by 25 mm. The tension was 82 mm. Hg (Schiötz) in each eye. Corneal curvature was 49.5 D. in each eye, with a 6.8-mm. radius of curvature. Corneal diameters were 11.5 mm. horizontally and 11.1 mm. vertically. The pupils were unequal, the left being twice as large as the right; both reacted to light, the right being very sluggish.

Slitlamp examination: The right eye revealed an absence of epithelial edema. There was a whitish calcified thin infiltration at the level of Bowman's membrane in the area of the lower nasal part of the palpebral fissure. The endothelial mosaic was quite distinct.

The anterior chamber was of average depth in the center, but shallow peripherally. No beam nor cells were visible. The iris dilated to 7 mm., and was of a light greenish-brown color, with several minute atrophic areas near the pupillary margin.

The lens was very tremulous and subluxated nasally a small distance. The lens capsule appeared to be detached or torn near the equator from the 6- to 8:30-o'clock position, and was retracted and wrinkled in horizontal folds over the lower half of the lens surface. There were several deep fluid clefts in the cortex with cloudy swelling of the lens substance.

The left eye revealed a normal cornea with nonedematous epithelium. The anterior chamber was shallow in the axial part, and measured optically 1.65 mm. The average depth in a myopic eye is 3.846 mm., according to the figures Raeder[1] published in 1922. The greenish-brown iris was well dilated. The lens appeared almost globular in shape. The equatorial margin illuminated by reflected rays from the fundus could be seen around the entire circumference. The anterior zonular insertion was seen as a series of fine cobweblike threads, rather irregularly arranged and sparser than normal; some, detached from the origin, were seen lying curled up on the surface of the lens. There was a faint anterior subcapsular opacity near the 7-o'clock position.

The zones of discontinuity were clearly marked and their widths did not vary markedly between the poles and equator, where they are normally much more narrow. Fine punctate cortical opacities were diffusely present.

The convexity of the posterior surface was judged to be greater than that of the anterior surface.

Fine lens tremors were noted, upon slight ocular movements. Optically, the sagittal diameter measured 4.8 mm. (The normal average is 3.76 mm., according to Zeeman,[2] 1911.) The average equatorial diameter was 7.3 mm. (normal average 9 mm., Duke-Elder[3]).

Ophthalmoscopy: The fundus of the right eye could not be seen. In the left eye, the media were clear, and the disc was round, with a deep glaucomatous excavation reaching to the temporal inferior and superior margins. A good shoulder of the nerve tissue remained nasally and the main trunks of the vessel rested upon it. The upper and lower branches bent over and disappeared as they passed the superior and inferior disc margins. The floor of the disc was a dirty reddish-gray in color. No myopic choroidal nor retinal changes were seen in the posterior pole or peripheral areas.

Visual-field studies of the left eye revealed a marked nasal constriction, which, together with superior and inferior Bjerrum scotomata, left a central field within the 20-degree circle, but tem-

Fig. 1. (Meyer and Holstein). Family of our cases. The second, third, fourth, and fifth from the left are patients in our series. Mother and father are at extremities. Note facial resemblance of mother and father, who are first cousins.

poral peripheral preservation almost to the 70-degree extent gave a fairly wide temporal field, especially below.

Retinoscopy of the left eye under 2-percent homatropine cycloplegia revealed -24.00 D.sph. $\bigcirc\!\!\!-$ -2.00 D.cyl. ax. 180°, which resulted in a corrected vision of 20/70.

Gonioscopic examination of both eyes revealed the chamber angles to be free and open.

Tension studies were made with reference to the state of the pupil and the time of day. Miotics did not always produce the paradoxical reaction reported by Urbanek,[4] but on several occasions produced an abrupt rise in an already hard eye. Mydriatics appeared to have no effect under ordinary conditions, but the use of homatropine helped to reduce the rise of tension following pilocarpine instillation. Usually the tension was considerably lower in the evening and at night than in the morning or during the daylight hours, when the patient was up and about.

On December 1, 1939, a loop extraction of the lens of the right eye was performed under local anesthesia by the senior author. The usual preparations of Van Lint akinesia, retrobulbar novocaine anesthesia, and superior-rectus bridle suture were employed. A single corneal scleral suture was placed before the Von Graefe corneal incision was made in the upper two fifths of the limbus. Complete iridectomy was made at 12-o'clock position with an iris hook and de Wecker scissors. The loosely dislocated lens was removed with a Weber loop without any loss of vitreous, and the corneal incision tightly closed with the previously placed suture. Atropine (1-percent solution) was instilled, and an uneventful recovery took place. The equatorial diameter of the lens measured 7.0 mm. The axial diameter was 5.8 mm., and the volume 0.18 c.c. (The normal average is 0.2 c.c. according to Duke-Elder.[3])

On about the fifth postoperative day, a scroll-like grayish structure was noted in the vitreous of the eye that had been operated upon, and identified as retinal tissue. The intraocular tension on the tenth postoperative day was R.E. 17.5 and L.E. 60 mm. Hg (Schiötz).

Examination of the right eye at this time revealed questionable light percep-

tion. The area of the corneal scar was found to be vascularized. The anterior chamber was fairly deep and contained a vitreous hernia. The vitreous body contained numerous pigment granules, and there was an almost complete funnel-shaped detachment of the retina.

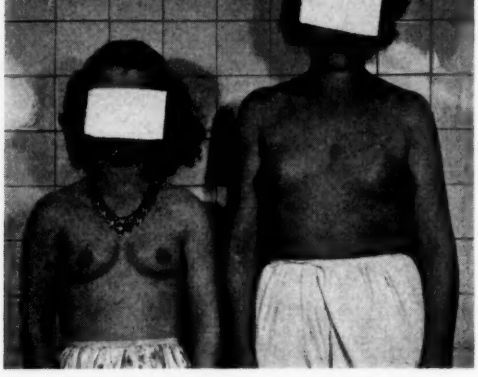


Fig. 2 (Meyer and Holstein). Shows relative development and proportions of the patient in case 1 (left) and an average-sized girl of the same age.

On January 8, 1940, the thirty-seventh postoperative day, the tension in the right eye was 82 mm. Hg, vision nil, with a completely detached retina.

Because of the poor outcome in the right eye, and because of unfavorable reports in the literature of all similar eyes which had been operated upon, the left eye was not operated on, in spite of the high tension.

General physical examination of the patient furnished by Dr. S. B. Mannel of the Cook County Hospital follows:

A systemic inventory revealed a history that was negative except for the following: dyspnoea on moderate exertion, but no heart consciousness or edema. Her negative menstrual history had its onset at the age of 14 years. Her tonsils and adenoids were removed the same year. Measles and chickenpox were contracted during her preschool years. During the past two years she apparently had hay fever from August through October. She believes she is sensitive to face powder. Both parents, two sisters, and one brother suffer from hay fever during the same season. The above-mentioned and two other brothers are living and in comparatively good health.

Apparently none of the grandparents had hay fever nor ocular pathology. However, the maternal grandmother, who is slightly taller than the patient, is afflicted with hypotension. The paternal grandfather died of carcinoma of the mouth.

Physical examination revealed a well-developed and well-nourished white female, 54½ inches tall, intelligent and cooperative. The basal metabolic rate was +19 percent, the blood calcium 9.6 mg. per 100 c.c., and the blood phosphates 3.05 mg. per 100 c.c.

Her head showed no evidence of enlargement, but her forehead was prominent and unusually steep. The tongue was clean and many carious teeth were present.

On percussion the heart seemed slightly enlarged to the right and left. Loud, blowing, systolic murmurs were heard over the entire precordium, and a systolic murmur was detected in the left axilla. The rate was normal and the rhythm regular.

The disproportion of the torso to the extremities was most striking. The upper extremities were shortened and extended down to the level of the head of the femur. The hands were stubby and the fingers short, with the index, middle, and ring fingers of about the same length; the little fingers did not extend to the first phalangeal joint of the ring fingers; at their bases the fingers were wide—apparently the trident type of hand. There was shortness of both femoras and tibias. The feet were short and stubby, toes being very short. Both extremities were quite muscular.

Case 2. G. B., female, aged 26 years, single, the oldest sister of the first patient, was admitted to the Illinois Eye and Ear Infirmary on December 27, 1939, for an eye examination. Her only complaint was poor vision in the left eye, which has turned out since childhood.

There was no previous history of any acute attacks of pain or visual disturbance such as halos about lights, although at intervals she had had periods of pain in and about the eyes associated with headaches. Glasses were first worn at the age of seven years, and have been changed twice since.

External ocular examination revealed normal-sized orbitae, in spite of small general stature. There was no injection of the eyeballs, and the left eye was divergent 20 degrees, and directed downward about 5 degrees. The right eye was the fixating eye. Ocular movements were unrestricted.

Vision was found to be: O.D. 16/200 corrected to 20/70 with −16.00 D. sph.; O.S. 6/200 corrected to 16/200 with −16.00 D.sph.

Tension on admission was right 24 mm. and left 12.5 mm. Hg (Schiötz). The following morning a tension of right 23 mm., left 15 mm., dropped to right 19 mm. and left 11.5 mm. after homatropine retinoscopy. Two days later tension of the right eye was 30 mm. and of the left eye 23 mm. with 6-mm. pupils, brought down to right 23 and left 15 in one hour, following instillations of 2-percent pilocarpine-HCl in each eye. The pupils contracted to 2.5 mm.

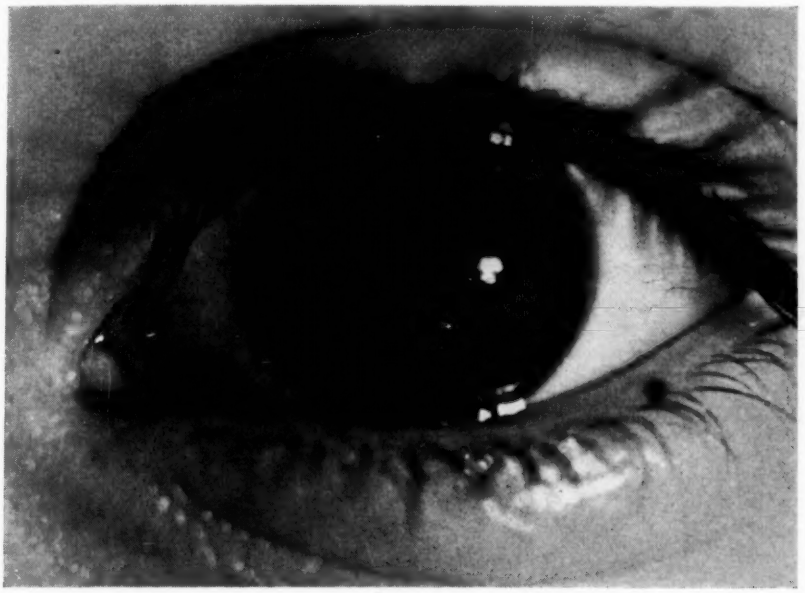


Fig. 3 (Meyer and Holstein). Left eye of patient M. A. B., showing the equatorial periphery of the crystalline lens, and clearness of the cornea with high tension.

Corneal measurements revealed in the right eye a radius of curvature of 6.7 mm. vertically and 6.9 mm. horizontally; in the left eye 6.95 mm. vertically and 6.8 mm. horizontally. The vertical diameter of each cornea was 11.5 mm., the horizontal diameter being 12.8 mm.

Both pupils reacted normally to light.

Slitlamp examination of the right eye revealed a cornea with fine white granular deposits on the posterior surface, occa-

sionally interspersed with pigmented granules. The anterior chamber was quite deep, more so in the nasal than in the temporal periphery. The axial depth was 2.2 mm.

positions the collarette was actually pulled forward by heavier strands towards the center of the pupil, so that the uveal-pigment collar was partially inverted at these points. Union of these strands

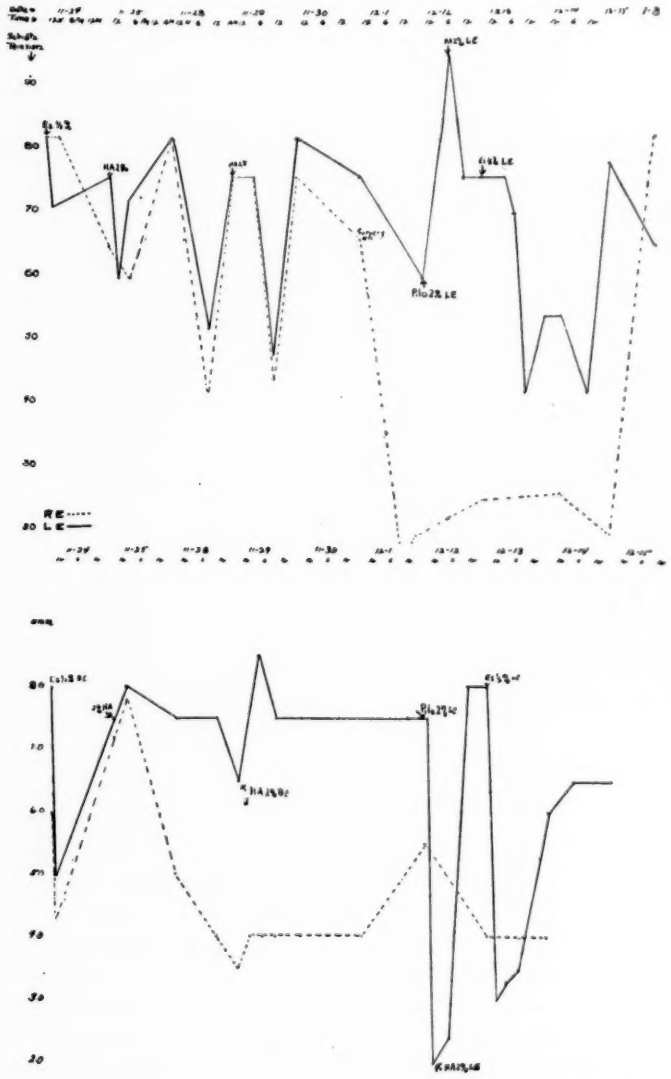


Fig. 4 (Meyer and Holstein). Upper chart shows the tension curve. Eserine on two occasions produced little or no effect. Pilocarpine caused a sharp rise, reduced by homatropine. Most consistent reduction in tension took place when the patient retired and lay quietly on her back asleep. After surgery, the tension gradually returned to the former high level and remained there. Lower chart shows the diameter of the pupil. For the most part it did not vary inversely with the tension, as in Shapira's case, except when pilocarpine was instilled.

The iris exhibited considerable iridodonesis. The pupil was eccentric nasally and upwards. The color was light blue to tan, with pupillary-membrane strands running from the 8- to 6-o'clock across to the 12- to 6-o'clock positions on the iris dial. At the 2-, 2:30-, and 3-o'clock formed a delicate meshwork on the surface of the nasal aspect of the lens capsule.

The anterior convexity of the lens was more acute than normal. The anterior-posterior or sagittal diameter was 5.7 mm. The equatorial diameter was about

7.3 to 7.5 mm. The equator and the zonular insertions were visible from the 9- to the 11:30-o'clock positions, to the subluxation downward and nasally. The zonula was remarkably thinned and sparse in the exposed segment. The posterior convexity was even more acute than was the anterior, being practically dome-shaped. The zones of discontinuity were clearly demarcated and the bands were of continuous uniform width. The capsule and subcapsular areas were clear, but the anterior cortex contained many fine punctate opacities. The superficial part of the adult nucleus, both anteriorly and posteriorly, was studded with numerous, various-sized, round, punctate, spicule-shaped and flattened white opacities, and gave the effect of a bursting rocket. The fetal and embryonic nuclei were clear except for three small crystalline axial opacities. The posterior capsule was normal.

The architecture of the anterior vitreous appeared normal and the inevitable hyaloid traces were present.

Left eye: The cornea revealed fine, whitish punctate deposits at the level of Bowman's membrane, situated in the lower half of the palpebral-fissure area. Fine, brown, granular deposits were on the posterior corneal surface. The anterior chamber was fairly deep, more so temporally than in the center or nasally. The axial depth was 2.2 mm.

The iris showed marked iridodonesis. The pupil was well dilated (7 to 8 mm.), but slightly eccentric nasally and upward, and fairly round. The iris was bluish tan in color. The pupillary-membrane remnants were more in evidence than they were in the right eye, and appeared to be exerting considerable traction on the collarette at various points towards the center of the pupil. These strands were attached in the form of fine fibrils to the anterior capsule of the lens near the equator, almost suggestive of an accessory anterior-chamber zonule. They were present in segment fashion from the 10- to 2-, 12- to 2-, and 4- to 6:30-o'clock positions, aiding in suspension of the lens. There was some slight atrophy within the lesser iris circle exposing the region of the sphincter.

The lens appeared to be subluxated and tilted backwards on its vertical axis several degrees temporally, and was tremulous with eye movements. The periphery was visible nearly to the equator on the temporal hemisphere. The temporal equatorial reflex was visible by nasal illumination. The anterior capsule, subcapsule, and cortex were clear. The superficial part of the adult nucleus was spangled with varying-sized, white, flattened opacities as in the right eye, but the axial region was relatively free. The embryonic nucleus presented a few axial crystals. The anterior lens convexity was increased, but the posterior was very marked as in lentiglobus. The sagittal diameter measured 6.3 mm., and the equatorial about 7.0 to 7.2 mm.

Hyaloid remnants were noted behind the posterior capsule. The vitreous was somewhat fluid.

Ophthalmoscopy revealed in the right eye a round disc of good color, without any cupping or atrophy. The vessels, macula, and peripheral retina were normal. The fundus of the left eye was similarly negative.

The patient's height was 55½ inches.

The reports of cases 3 and 4 were kindly furnished us by Dr. A. G. Schulz of Jacksonville, Illinois, because the patients could not be brought to the infirmary this year.

Case 3. Miss W. B., aged 23 years, another sibling in the same family, was examined at the Illinois School for the Blind, where she is an inmate. The patient seemed quite intelligent during the interview and examination. She stated that she had had no eye trouble during her early childhood. She attended public

school until the age of nine, when she developed "measles." Her eyes became painful and sensitive to light and her vision failed rapidly without remission. In February, 1937, she underwent an operation on her left eye.

Examination: Physically the patient appeared well nourished but undersized, measuring only 54½ inches in height.

There was light perception present in both eyes with poor projection and color sense. The left light perception was somewhat weaker than the right, requiring a stronger stimulus. The tension was found to be: R.E. 1+ (by touch; tonometry impossible); L.E. = 16.5 mm. Hg (Schiötz).

Right eye: The conjunctiva and external ocular movements were normal. The cornea was of normal size but contained two dense band-shaped leucomas. One leucomatous area was at the center of the cornea and about 5 mm. in diameter. The other opacity was just above the lower-lid margin when the eye was open and measured 7 x 2 mm. The opacities appeared to be infiltrated with calcium deposits. No vascularization was present. Above and below these leucomatas was fairly clear cornea. The anterior chamber was very shallow. The pupillary margin could not be seen, but the iris appeared immobile to light. Transillumination of the eyeball displayed the very atrophic condition of the iris.

Left eye: The cornea was clear and normal in size. At the limbal margin from the 4:30- to 7:30-o'clock position there was a partial incarceration of the iris. The pupil was pear-shaped, 4 x 6 mm., with the apex toward the incarceration. Reaction to light was good. Iridodonesis was marked and the lens was absent. The vitreous was clear and the optic disc appeared atrophic. Vascular attenuation was marked.

Case 4. This patient, E. B., a white male, aged 21 years, is one of the three brothers of the sisters mentioned herein.

At the age of nine, this patient states, his vision began to fail. The following year he had to leave public school because of poor vision. He was brought to the Illinois Eye and Ear Infirmary in March, 1929. We were able to find only part of his hospital records in the files. These indicate that his tension ranged between 40 and 60 mm. Hg (Schiötz). Eserine had been administered but did not help, and the patient was discharged unimproved.

Examination: The patient was a rather stockily built young man only 57 inches high.

No light perception was present in either eye.

Power to elevate the eyes voluntarily above the horizontal plane was absent. However, Bell's phenomenon was present. Both eyeballs appeared small and atrophic.

The right eyeball was pale and soft. The corneal diameter was 9 mm. The cornea was vascularized anteriorly and posteriorly. Descemet's membrane was very wrinkled. The anterior chamber was deep in the upper half and shallow in the lower half. The pupillary margin was irregularly 2 x 3 mm. in diameter due to synechiae and thick connective-tissue adhesions binding it to the lens. The iris appeared very atrophic. The lens was pearly white and cataractous. The fundus could not be seen.

The left eyeball was pale and soft. The cornea was 9 mm. in diameter. A 3-mm. pannus covered the upper third, and the lower third presented small calcareous deposits in Bowman's membrane in the palpebral-fissure area. Vascularization, deep and superficial, and folds in Descemet's membrane were present. The visible part of the anterior chamber was of average depth. The pupil was bound to the lens by synechiae. The dense cataract prevented a view of the fundus.

Discussion

On the basis of our findings and those reported in the literature on microphakia, certain definite facts may be established. The lens in its entirety is definitely smaller than normal. However, even Vogt[5] admits that this observation may be difficult to make. He found the equatorial diameter in his cases to be 7.5 mm. Fleischer's case,[6] in which the lens was extracted intracapsularly, had an equatorial diameter of 6.75 mm. Vogt found the sagittal diameter of his spherophakic lenses to be one fourth larger than normal when measured with the aid of a slitlamp. Our lenses were of similar size, the equatorial diameter being 7.0 mm. This is in direct contrast to the size of lenses found in congenital ectopia lentis, where the equatorial diameter is as large or larger than normal. The spherophakic lens may lie slightly eccentrically, may be slightly or markedly tremulous, and may even be luxated into the vitreous or into the anterior chamber. The anterior chamber may be of normal or greater-than-normal depth if the lens is quite loose. In such cases, the increased sagittal diameter of a lens may be easily overlooked. From our observations, we believe that subluxation of the lens and iridodonesis of the lens are late sequelae in such cases.

Spherophakia usually results in a marked myopic refraction, which may be designated as a pure lens myopia. In our cases and those noted in the literature, there were no evidences of any myopic fundus changes. Furthermore, in the cases of both Fleischer[6] and Vogt,[5] in which the lenses were successfully extracted, the resultant refractive error was identical with that of an emmetropic aphakic eye. In Marchesani's case,[7] in which the lens was subluxated posteriorly, the myopia was much less marked. In two of Marchesani's cases, without lens luxation, chronic glaucoma was present. Gnad[8] reports 5 of 15 cases noted in the literature as having an increased tension. In our first case, the tension was markedly increased. The tension increased with the use of miotics, similarly reported by Fleischer[6] and Gnad[8] but mydriatics lowered the tension somewhat. Urbanek[4] believes that pupillary contraction following the administration of miotics in a case of spherophakia results in a closure of the pupillary aperture due to a ball-valvelike effect of the iris on the abnormally thick lens, and results in a further increase in tension. However, in our case a high tension was maintained even when the pupil was so widely dilated that an aphakic zone was present.

Vogt[5] found the zonular fibers to be abnormally long and somewhat degenerated. This may account for the iridodonesis present. He believes that the zonular fibers are originally rudimentary in character and only secondarily become abnormally long. He also postulates the theory that the lack of tension of the rudimentary zonular fibers on the lens results in its immature development, so that it remains spherical, as in the newborn and in complete accommodation.

Marchesani[7] believes that there is a definite relationship between lens anomalies and growth anomalies, and that spherophakia is a part of a syndrome accompanied by brachydactyly. This condition is usually characterized by short stature, shortness of the hand and fingers, broad thorax, and strong musculature, combined with a good layer of fat and a brachycephalic head. This syndrome picture is in direct contrast to that found in arachnodactyly with congenital ectopia lentis, which is characterized by abnormally long extremities, tall stature, narrow thorax, deep set eyes, dolichocephaly, flat feet, and weak musculature. Marchesani presents considerable evidence to show that spherophakia with brachydactyly is fundamentally a dysplasia of

the mesodermal structures. He suggests the term "Dystrophia mesodermalis hyperplastica" for this syndrome in contrast to Marfan's syndrome which may be termed "Dystrophia mesodermalis hypoplastica."

Only about 20 cases of spherophakia have been reported to date, to which may be added our four cases. Cordiale[9] first reported a unilateral microphakia in 1901. T. M. Shapira[10] in 1934 reported two cases seen in the Elschnig clinic and included a comprehensive survey of the literature to that date, at which time, 18 cases had been reported.

Vogt classes spherophakia as a recessive trait, in contrast to arachnodactyly with congenital ectopia lentis, which is a dominant trait. This is supported by the fact that in numerous cases, including ours, consanguinity in the family tree was present. Marchesani, by showing that brachydactyly without spherophakia was present in both families of one of the parents of the patient he reported, offered the interesting conclusion that the anomaly is an intermediary trait, and that mild brachydactyly (forme fruste) may depend on heterozygosis, and the severe form with spherophakia, on homozygosis.

It is interesting to note that in spite of the high intraocular tension over a period of years, the peripheral field and corneal epithelium were fairly well preserved. Careful, repeated search for corneal epithelial edema revealed none at any time (although it may have been present on occasions from the patients' subjective symptoms). This is in contradistinction to the known fact that most eyes with an intraocular tension of over 40 mm. Hg (Schiötz) have a corneal edema.

Two possible explanations may be presented for the prolonged protection of the corneal epithelium and the retinal nerve fibers from the effects of increased intraocular pressure. First, the occurrence of high tension at so active a period in the development of fibrous structures (as prepuberty and puberty) may stimulate a corneoscleral adaptation structurally to a condition of high pressure from within, which becomes normal for this particular corneosclera. Second (which is perhaps more plausible in view of the stretching of these coats in buphthalmos and in other cases of juvenile glaucoma), the corneoscleral stroma and mesodermal condensation may take a part *pari passu* with the other mesodermal hyperplasias found in this disease, which we believe affects the ciliary body in a manner explained below, and results in a sturdier corneosclera, which may protect the delicate nerve head and corneal epithelium for a considerable time.

The defectiveness of the ectodermal lens and zonule may be explained on a mesodermal basis, as well, by invoking the fact that development of the lens and zonule depend upon the development of the ciliary body, largely of mesodermal origin. In the newborn, the lens has a spherical shape. Thus, arrest of ciliary development then could leave a condition of congenital spherophakia. But from the history given by our patients, the symptoms of spherophakia were not present until late childhood. We know that in maximum accommodation, the lens also tends to assume a spherical shape. Hyperplasia of the ciliary body would have the same effect upon the zonule and lens. Thus it would not be too conjectural to assume that paralleling the premature development and closure of the epiphyses there is a precocious development of the mesodermal tissues of the eyeball, uncompensated for by similar ectodermal development, resulting in spherophakia and glaucoma.

58 East Washington Street.

References

[1] Raeder. 1922.
[2] Zeeman, W. P. C. Linsenmessung und Emmetropisation. Arch. f. Ophth., 1911, v. 78, pp. 93-108.
[3] Duke-Elder. Text book of ophthalmology. Vol. II.
[4] Urbanek. Glaucoma juvenile inversum. Zeit. f. Augenh., 1930, v. 77, p. 171.
[5] Vogt, A. Lehrbuch und Atlas der Spaltlampenmikroskopie. Berlin, J. Springer, 1931, v. 2.
[6] Fleischer. Abnorme Kleinheit und Kugelgestalt der Linse bei zwei Geschwisterpaaren. Arch. f. Augenh., 1916, v. 80 p. 248.
[7] Marchesani, O. Brachydactyly and congenital spherophakia as a systemic disease. Klin. M. f. Augenh., 1939, v. 103, p. 392.
[8] Gnad. Ueber Mikrophakie. Klin. M. f. Augenh., 1931, v. 87, p. 33.
[9] Cordiale. Un cas de microphakie. Ann. d'Ocul., 1901, v. 2, p. 346 (Saeger).
[10] Shapira, T. M. Micro- and spherophakia with glaucoma. Amer. Jour. Ophth., 1934, v. 17, p. 726.

ACCIDENTAL INVOLVEMENT OF THE EYES IN VACCINIA*

Adolph O. Pfingst, M.D.
Louisville, Kentucky

Vaccinia, also known as cowpox and vaccine disease, is, as you know, a specific contagious affection occurring in cattle, usually in epidemic form. It was first described late in the eighteenth century by Edward Jenner, who, after 16 years of research regarding the analogy of variola to vaccinia, came to the conclusion that cowpox is smallpox of the human, modified by transmission through the system of the cow. This view is maintained at the present time.

Vaccinia attacks the teats and portions of the udder of the milch cow. After an incubation period of from five to eight days, the disease appears in the form of multiple papules which soon change to umbilicated bluish vesicles, later becoming pustular and finally rupturing, leaving ulcerated surfaces which terminate in crust formation and desquamation.

In his early research, Jenner established the fact that cowpox is communicable to man, and reported numerous instances of accidental infection of the fingers, hands, arms, and lips of those engaged in milking affected cows. Further observation revealed the fact that milkers who had accidentally contracted vaccinia became practically immune to small-pox. This led Jenner to inoculate the human with the contents of a cowpox pustule to induce an attenuated attack of vaccinia and thus establish immunity against smallpox. After repeated experiments during the course of two years Jenner[1] published his observations in 1798, and advocated vaccination against smallpox as a routine measure.

During the prolonged period in which vaccination has been performed millions of times throughout the world, it has been observed that the procedure may, although infrequently, be associated with the development of local or constitutional complications of annoying, though seldom of a serious, nature. Disregarding those cases marked by an immediate, somewhat severe local reaction accompanied by febrile disturbance, frequently noted following vaccination, one of the earliest complications recorded is the development of a narrow zone of erythematous dermatitis around the point of vaccination. Less frequently, a few typical cowpox vesicles have been observed in the immediate vicinity of the vaccinated area.

*Read before the American Ophthalmological Society, at Hot Springs, Virginia, June 4, 1940.

Another sequel occurring several days after vaccine inoculation maybe a generalized erythema or eczema involving the skin of the entire body. This complication is relatively infrequent, and is, perhaps, an anaphylactic reaction. It has no prognostic significance. Another evidence of anaphylactic reaction following vaccination is the development of a general urticaria.

A complication occurring infrequently is the appearance of a disseminated papular eruption involving the trunk and extremities, manifesting itself in from 4 to 10 days after a successful vaccination. According to Schamberg,[2] this complication passes through the successive stages characteristic of vaccinia. The skin usually clears up in three or four weeks, but the eruption may be followed by a succession of recurrent attacks extending over a period of several years. This hematogenous or metastatic postvaccinal generalized eruption is presumably brought about by the unaccountable entrance of vaccination lymph into the blood stream at the site of inoculation.

Regarding the prognosis of these cases, I quote from J. D. Rolleston:[3] "The prognosis of generalized vaccine is good. The condition is likely to be serious and even fatal only when it supervenes on a preexisting dermatosis, especially eczema, seborrheic dermatitis, or impetigo."

Various instances of neurogenic affections following vaccination have been found in recent literature. For example Y. V. Konovolav[4] reported a case in which anterior poliomyelitis followed smallpox vaccination. The same author also cited two fatal cases of encephalitis following vaccination. A case of postvaccinal encephalomyelitis occurring in a boy, aged 14 years, was reported by Zimmerman and Cochran,[5] and one of meningoencephalitis by Mirano.[6] In some of these cases the results were attributed by the authors to accidental contamination of the vaccine virus.

Valenti,[7] reported a case of Calvé-Perthes disease of the upper epiphysis of the femur following vaccination in a boy aged nine years. This complication could in all probability be attributed also to contamination of the virus with pathogenic organisms.

Acute nasal infections superinduced by vaccination have been recorded by Weinhold[8] and others. Other unusual conditions resulting from accidental infection of the vaccination process are erysipelas, impetigo, tuberculosis, and syphilis.

The most frequent complications that follow vaccine inoculation are those involving the eye and its adnexa, although when one considers the vast numbers of vaccinations performed, even these complications occur with relative infrequency. Presumably, however, they do occur with greater frequency than we realize, for it is fair to assume that many of the ocular complications occurring in vaccinia are not reported in ophthalmic literature. In this connection it is interesting to note that a German zoölogist, Blochmann,[9] whose own child lost an eye following vaccination against smallpox, made a very careful study of every case of postvaccinal complication reported in general medical literature, from Jenner's time to 1904, and found 250 cases in which the eyes were involved. On the other hand, Bedell,[10] studying the reports available in ophthalmic literature up to 1920, made no reference to Blochmann's report, and included only 93 cases. A further contribution by Folk and Taube,[25] in 1933, included but six additional cases, thus bringing the total to 99. As a result of this statistical discrepancy an endeavor was made to summarize the cases that have been recorded in ophthalmic literature in the nine years following these publications (1930 to 1938, inclusive). This revealed a surpris-

ingly frequent occurrence of ocular vaccinia as compared to the statistics of Bedell, and of Folk and Taube. A very brief survey of these more recent cases follows:

Toulant,[16] accidental corneal infection in a woman, aged 32 years, contracted while working with vaccine tube.

Munns,[17] vaccinia of eyelids occurring in a child, aged six years, six days after she had touched the moist vaccination scar on her leg.

Marin and Amat,[18] vaccine pustule occurring on eyelid of one eye in a child, aged two years, two days after she had touched one of the pustules on her arm.

Marin and Amat,[19] ulcer of the cornea appearing eight days after accidental inoculation by physician. In breaking lymph tube vaccine had splashed into the eye.

Schmelzer,[20] four cases of lid vaccinia in children, two due to homo-inoculation and two to hetero-inoculation.

Aracri,[21] seven cases of vaccinic lesions of the eyes. All had developed pustules on one or both lids. Two were due to homo-infection, five to crossed infection.

Montanelli,[22] four cases of pustular eruption of the eyelids. Three of the cases were hetero-infections. The author also cited a case in which a girl, aged 16 years, five days after successful vaccination developed a unilateral acute conjunctivitis with a well-defined ulcer covered with a pseudo membrane on the nasal side of the bulbar conjunctiva.

De Petri,[23] six cases of vaccine pustules at the palpebral margin; one case with superficial corneal infiltration. Four of the cases were hetero-infections.

Portoghese,[24] three cases, including one of generalized vaccinia in a child, aged 14 months, in which the eyelids were coincidentally invoved. The other two, one of them the mother of the first, were both cases of heterogenous unilateral infection involving the skin of the eyelids.

Folk and Taube,[25] vaccinia of the eyelids and conjunctiva in a child who had not been vaccinated, and in whom transmission had evidently occurred from one of the three other children who had been successfully vaccinated eight days before.

Sezer,[26] accidental inoculation of the conjunctiva of the right eye in a boy, aged eight years, becoming apparent five days after vaccination in the form of a well-defined ulcer on the palpebral conjunctiva. The boy also had multiple ulcers at the ciliary margin and one pustule on the right cheek.

Sinaiko,[27] under the title "Keratitis post-vaccinolosa," reports the case of a child, aged six years, with keratitis of the right eye which developed three days after vaccination. There was only a moderate amount of conjunctival inflammation, but at the center of the cornea there was a superficial opaque area, 5 mm. in diameter. A diagnosis of disciform keratitis due to infection of the eye with vaccine virus was made, based on the fact that the child had scratched the vaccinated area on the arm with her hand and with the same hand had rubbed her right eye.

Ortmann,[28] ulcerations appearing on edge of the eyelids of the right eye of a child, aged one and one-half years, four days after vaccination.

Friede,[29] ocular disease following vaccination, but details not available.

Benetazzo,[30] two cases of accidental vaccination of eyelids. Details not available.

In addition to these reports, which represent a total of 36 cases, quite a few others were cited in the literature in which detailed reports were missing. Allowing also for a few reports that may have been overlooked, it is evident that accidental vaccination of the eyes occurs with a surprisingly greater frequency than former statistics would seem to indicate.

The question of the mode of transmission in cases of accidental ocular involvement has always been of interest, and even today remains unanswered. Although some pediatricians lean to the belief that a preëxisting abrasion, even though slight, is essential to the development of the virus on the skin, it appears that the majority of observers hold to the view that mere contact with the contents of the vaccination vesicle is sufficient to bring about ocular vaccinia. As the manifestation so frequently occurs first at the lid margin, especially at the outer canthus, the belief prevails that the ever-susceptible conjunctiva serves most frequently as the medium of transmission. This deduction has been upheld by Folk and Taube,[25] who made experimental inoculations in rabbits and found that the conjunctiva may become involved after mere contact of vaccine lymph or pus without friction.

Another interesting observation regard-

ing transmission is the greater frequency of ocular infection occurring in individuals who have not themselves been vaccinated, such as mothers or other attendants of vaccinated children. The histories of the cases compiled by Folk and Taube[25] reveal the interesting fact that only 25 percent could be attributed to homeoinoculation as compared to 75 percent of hetero-transmission.

If we accept the view that the conjunctiva offers the most fertile soil for a "take" of vaccine inoculation, we must necessarily look upon the conjunctiva as relatively the most frequent of the ocular tissues to be involved in vaccinal inoculation. The reaction is usually quite severe, and is marked by considerable chemosis and frequent subconjunctival hemorrhage, and often results in pustular formation of the bulbar or palpebral conjunctiva and subsequent ulceration. The process spreads by continuity to the skin, which accounts for the frequency of blepharitis with blebs at the lid margin. However, many cases have also been recorded in which primary vesicular development occurred on the skin of the eyelids somewhat removed from the margin.

Fortunately, the cornea does not participate frequently in the infectious process, although infiltration of the corneal structures is not infrequent. Most of the reported corneal cases occurred secondary to palpebral lesions, and represented a real ulcer with a break in the surface, thus involving the substantia propria and terminating in scar formation and amblyopia. In 80 cases of vaccinia of the eyes tabulated by Ball and Toomey[15] the cornea was involved to a greater or less degree in 10 percent of the cases.

A case of true corneal pustule occurring eight days after direct injury to the cornea by a splinter of glass from a broken lymph tube, previously mentioned, was reported by Marin and Amat.[19] In this case a progressive ulcer developed, which left an extensive leucoma and practically a blind eye.

An unusual corneal condition following vaccination and associated with a vaccinal ulcer of the lid was observed by Schirmer.[11] It was described as a well-circumscribed central superficial opacity not involving the substantia propria, and was compared to the disciform keratitis of Fuchs.

A very unusual sequela of vaccination was reported by Roberts[12] in which infection of the left lower eyelid occurred by transmission from the site of inoculation on the arm, followed by infiltration of the cornea and the discharge of a large hemorrhage into the anterior chamber. The author attributed the hyphemia in this case to an acute inflammation of the uveal tract.

Another unusual ocular complication of vaccinia was reported by Ibershoff,[13] that of unilateral chronic uveitis with secondary glaucoma. He attributed the deep ocular inflammation to vaccinia, as it followed soon after vaccination, although he did not exclude the possibility of faulty technique and possible mixed infection.

In view of the many and frequent post-vaccination complications that arise, especially those involving the ocular structures, every possible precautionary measure should be instituted to prevent such accidents. It would seem to the writer that more care should be given to the nature of the protective covering applied to the area of vaccination, and that preventive measures regarding the handling of the vaccinia vesicle would result in fewer cases of ocular vaccinia.

The vast number of ocular lesions that have been recorded following vaccination by direct or crossed transmission would naturally lead to the assumption that direct infection of the eyes on the part of dairy workers and farmers from the pock

of the diseased cow would not be an uncommon experience. This deduction, however, is not borne out by clinical observation, for, after diligent search of American and foreign literature, only a single instance of this kind was found. It was reported by Cruickshank[14] in 1910, and occurred in a farmer, aged 33 years, who had milked cows that had an eruption on their teats and had infected his own eyes by rubbing them with his fingers. He had not been vaccinated recently nor had he been exposed to others who had. The ocular symptoms developed at an uncertain period after exposure, and came on with considerable constitutional disturbance, associated with swelling of the eyelids and chemosis of the conjunctiva. Coincidentally, a papule had developed on the skin of the right lower lid which subsequently went through the stages of vesiculation, pustulation, ulceration, and scab formation characteristic of vaccinia. There was no corneal involvement. The case made an uninterrupted recovery. Cruickshank concluded that vaccinia accidentally carried from an affected cow goes through the same stages as those produced by vaccine lymph or by infection from the vaccination pustule, though it runs a more severe and protracted course.

We have recently encountered a similar case of ocular vaccinia, attributable to direct transmission from the cow, which, in view of the sparsity of such cases, may be of interest:

Case report

G. W. K., dairyman, aged 71 years, when first seen on January 5, 1938, gave a history that his left eye had begun to burn and itch four days previously. This was soon followed by similar discomfort in the right eye. As the symptoms increased in severity the eyes became quite sensitive to light. The left eye felt as though there was something under the upper lid and became painful. The lids of both eyes had been swollen for two days coincidentally with a watery and later a mucopurulent discharge. The patient had noticed an oozing of blood from under the left upper lid for 24 hours. When questioned regarding the possibility of an injury or of exposure to infection, the patient, a man of intelligence, spoke of an epidemic of cowpox which had been prevalent among his milch cows. He was sure that he had infected his eyes with his hands, but as he milked daily, could not determine the time that had elapsed between the eye infection and development of symptoms. However, upon discovering vaccinia among his herd he had discontinued milking. He did not remember ever having been ill. He was last vaccinated successfully when he was 12 years old, and had not recently been exposed to others who had been vaccinated.

Examination: A healthy-looking, robust man revealed swelling of the lids of both eyes, with considerable chemosis of the conjunctiva and some included hemorrhagic areas. Eversion of the left upper lid revealed an ulcerated area, 3 mm. in diameter, situated on its conjunctival surface near the middle, close to the margin of the lid. Blood was oozing from the broken area. The cornea was clear as was also the iris. The cornea of the right eye was slightly infiltrated at its upper margin; the iris was normal; both pupils were responsive to light; the preauricular glands on the affected side were enlarged and tender. Vision R.E. was 20/20, L.E. 20/30; laboratory tests were all negative. A culture from the conjunctiva showed Staphylococcus albus. Efforts to obtain part of the contents of the vesicles from some of the cows for bacterial study proved futile, as the epidemic among the animals had subsided.

A diagnosis of vaccinia of the eye, self-inoculated from the cow through the

medium of his fingers, was made. An antiseptic wash, the instillation of adrenalin solution, and cold compresses were ordered. The patient did not return for three days, when the swelling of the lids had subsided. The cornea of the right eye was clearing, but considerable blood was oozing from beneath the upper lid of the left eye. As the chemosis had subsided, the ulcer of the lid appeared well defined and blood could be seen pulsating at its base. The ulcer was treated with electrocautery, after which the lid made an uninterrupted recovery and, when seen a week later, both lid and conjunctiva appeared to be almost normal.

A brief review of an unusual case, identical in its mode of transmission to the one just described, although in no way resembling it in its pathological formation, follows:

In 1935, Ludwig[31] reported from the eye clinic of the University of Prague a case of milker's nodules occurring at the margin of the upper eyelid of a milkmaid, which he attributed to rubbing of the eye with fingers affected with milker's nodules. These nodules had been transmitted from cows in which the veterinarian had found milker's nodules at the udders and had condemned the milk. The girl had not been vaccinated for three or four years. The tumor on the eye itched considerably, but was not painful, although tender on pressure. It resembled a large chalazion with a slightly nodular, strawberrylike moist surface. Histologically it consisted of granulation tissue. The preauricular glands were enlarged. The case was diagnosed in the dermatological clinic as a typical milker's nodule of the eyelid, caused by direct transmission from the cow through the medium of the milker's hand.

References

[1] Jenner, Edward. An inquiry into the causes and effects of variola vaccination. London, 1798.
[2] Schamberg. Diseases of the skin and eruptive fevers. Philadelphia, 1908.
[3] Rolleston, J. D. Generalized vaccinia. Brit. Jour. Child. Dis., 1937, v. 34, p. 187.
[4] Konovolav, Y. V. Augenkomplikationen der Vakzination. Klin. Med., 1928, v. 6, p. 1076.
[5] Zimmerman, C. A. W., and Cochran, J. H. A case of postvaccinal encephalitis. Jour. Missouri State Med. Assoc., 1932, v. 29, p. 158.
[6] Mirano, G. Meningoencephalitis following vaccination. Pediadria, 1937, v. 45, p. 717.
[7] Valenti, B. Disease of the upper epiphysis of the femur following vaccination. La Pediatria, 1932, v. 40, p. 248.
[8] Weinhold, H. Arch. f. Ohren-, Nasen- u. Kehlkopfh., 1936, v. 142, p. 208.
[9] Blochmann, F. Ist die Schutzpockenimpfung mit allen notwendigen Kautelen umgeben? Tübingen, 1904.
[10] Bedell, A. J. Multiple vaccination of the eyelids. Amer. Jour. Ophth., 1920, v. 3, pp. 103-107.
[11] Schirmer, Otto. An unusual corneal condition following vaccination. Arch. f. Ophth., 1904, v. 59, p. 133.
[12] Roberts, E. L. Hemorrhage in anterior chamber of the eye following vaccination. Amer. Jour. Ophth., 1922, v. 5, p. 397.
[13] Ibershoff, A. E. Unusual ocular complications of vaccinia. Jour. Ophth., Otol. and Laryng., 1915, v. 21, p. 121.
[14] Cruickshank, R. W. A case of ocular vaccinia. Brit. Med. Jour., 1910, v. 1, p. 984.
[15] Ball, J. M. and Toomey, N. Jour. Amer. Med. Assoc., 1922, v. 79, p. 935.
* For complete references to 1932 see Amer. Jour. Ophth., 1920, v. 3, p. 107, and 1933, v. 16, p. 38.
[16] Toulant, P. Ocular complications from accidental inoculation with vaccine. Paris méd., 1930, v. 77, pp. 190-193; also Arch. of Ophth., 1930, v. 13, p. 229.
[17] Munns, G. F. Accidental vaccination of eyelids. Amer. Jour. Ophth., 1931, v. 14, pp. 1037-1039.
[18] Marin and Amat, M. Vaccine pustule on eyelid. Med. Ibera, 1932, v. 26, pp. 73-74.

* The author's references to publications prior to 1932 are supplemental to the bibliography cited in the American Journal of Ophthalmology, 1920, v. 3, p. 107, and 1933, v. 16, p. 38.

**——. Corneal ulcer from accidental vaccine inoculation. Bull. et Mém. Soc. franç. d'Opht., 1936, v. 49, pp. 85-93.
**Schmelzer, H. Ocular lesions from vaccination and their prevention. Zeit. f. Augenh., 1933, v. 80, pp. 356-359.
**Aracri, A. Therapy of vaccinal lesions of eye. Boll. d'Ocul., 1931, v. 10, pp. 1516-1535.
**Montanelli, G. Diseases of eye from smallpox vaccination. Lettura Oftal., 1931, v. 8, pp. 135-165.
**De Petri, M. Ocular diseases from vaccinia. Lettura Oftal., 1931, v. 8, pp. 223-241.
**Portoghese, C. Vaccination causing ocular lesions. Ann. di Ottal. e. Clin. Ocul., 1934, v. 62, pp. 308-320.
**Folk, M. L., and Taube, E. L. Vaccinia of the eyelids and conjunctiva. Amer. Jour. Ophth., 1933, v. 16, pp. 36-38.
**Sezer, F. N. Accidental vaccination of conjunctiva. Arch. of Ophth., 1938, v. 20, pp. 89-91.
**Sinaiko, A. A. Keratitis postvaccinolosa. Arch. of Ophth., 1931, v. 5, pp. 91-92.
**Ortmann, K. K. Vaccine ophthalmia. Hospitalstid., 1932, v. 75, pp. 285-296.
**Friede, R. Klin. M. f. Augenh., 1930, v. 85, p. 427.
**Benetazzo, G. Two cases of accidental vaccination of eyelids. Dermosilfilgrafo, 1936, v. 11, p. 169.
**Ludwig, A. Milker's nodules of upper eyelid. Arch. f. Augenh., 1935, v. 109, pp. 346-352.
**Hackenthal and Koban. Conjunctivitis after intracutaneous infection with smallpox virus. Zentralbl. f. Bakteriol. (Abt. 1), 1930, v. 115, pp. 451-454.
Motolese, F. Vaccinal ulcer of eyelid with corneal complication. Lettura Oftal., 1930, v. 7, pp. 336-343.
Anelli, D. Vaccinoid pustule of lower eyelid of right eye produced by Micrococcus tetragenus. Boll. d'Ocul., 1932, v. 11, pp. 1265-1268.
Cvetojevic, M. Acute inflammation of uveal tract after vaccination. Voj.-san. Glasnik, 1933, v. 4, pp. 145-152.
Redslob, E. Fulminant blindness after smallpox vaccination in child 14 months old. Bull. et Mém. Soc. franç. d'Opht., 1935, v. 48, pp. 126-139.
Nikolic, V. T. Vaccinola; case of transmitted smallpox vaccine to the eyelids after vaccination. Voj.-san. Glasnik, 1937, v. 8, p. 461.
Juskeviciute, O. Ocular vaccinia. Medicina (Kaunas), 1938, v. 19, pp. 301-308.

** The unnumbered references represent inaccessible literature.

THE PROTEIN CONTENT OF THE RE-FORMED AQUEOUS HUMOR IN MAN*

PETER C. KRONFELD, M.D.
Chicago, Illinois
AND
(By invitation) C. K. LIN, M.D., AND T. H. LUO, M.D.
Peking, China

The primary aim of this and of previously reported work on the regeneration of the aqueous humor in man has been the analysis of the reactive processes which are set up in the eye by the withdrawal of aqueous humor from the anterior chamber (hereafter referred to as ACP). As criteria of the intensity of these processes, the degree and duration of the elevation of the intraocular pressure after ACP (the "hypertensive phase")[1, 2, 3, 4] and the rate of re-formation of the aqueous[5, 6] have been considered. The protein content of the re-formed fluid (hereafter designated as p_2) has suggested itself as a further criterion. During the process of its formation, as well as during its stay in the chambers of the eye, the composition of this fluid is influenced by the abnormal state of the eye, which is the result of or the reaction to the ACP. Histologically, in the rabbit, this state may be described as that of an acute circulatory disturbance on the order of active congestion and increased vascular permeability. In man the ACP causes qualitatively analogous but less pronounced histologic alterations.[7] *In vivo,* one hour after an ACP, the slitlamp reveals hyperemia of the iris if the latter is blue or gray, and increased turbidity of the aqueous, which also contains cells and minute coagula.

P_2 thus appears to be an indicator of the intensity of the circulatory disorder caused by the ACP. Although most of the evidence on the source of the re-formed aqueous in man presented in the controversy between Hagen[8] and Loewenstein,[9] on the one hand, and Wessely[10] and others, on the other hand, consisted of data on the protein content of the re-formed fluid, the actual number of reasonably accurate determinations that have been published is small (table 1). In these instances, the clinical conditions of the eyes from which the aqueous specimens were obtained as well as the method of protein determination varied so much that the only conclusion which can safely be drawn from these data is that in every instance p_2 was higher than p_1, the protein content of the original aqueous.

TECHNIQUE

The technique for withdrawing the primary and the re-formed aqueous humor as described here was adhered to in all typical or uncomplicated anterior-chamber punctures reported in this paper. Any deviations from this typical course will be noted when the respective experiment is referred to. Unless stated otherwise, the anesthesia consisted of four instillations of two drops each of 1-percent pontocaine, made at intervals of three minutes, plus the direct application of the same solution with cotton applicators to the lower and upper limbus, at which places the eyeball was held with two fixation forceps while the puncture was being

* From the Department of Ophthalmology, The Peiping Union Medical College, Peking, China. Presented before the American Ophthalmological Society, at Hot Springs, Virginia, June 4, 1940.

made. These punctures were made with sharp hypodermic needles, gauge no. 27, to which tuberculin syringes of 0.5-c.c. capacity were attached. The needle was introduced through the limbus (not slightly indented, which entailed a rise in intraocular pressure that we measured tonometrically on several occasions and found to vary from 3 to 7 mm. of mercury. The aspiration of the aqueous took

TABLE 1

THE PROTEIN CONTENT OF THE AQUEOUS—DATA FROM THE LITERATURE

Author	Method	Anesthetic	Clinical Diagnosis	P_1 gm. %	P_2 gm.%	Interval in Minutes
Wessely	Precipitation with Esbach's reagent; turbidimetry with naked eye	Holocaine	Endothelioma of orbit; optic atrophy	0.01	0.02	90
		Holocaine	Postneuritic optic atrophy	0.01	0.06	180
		Holocaine	Small sarcoma of the choroid	0.01	0.03	—
		Cocaine	Optic atrophy	0.01	0.03	30
		Apocaine	Amblyopia ex anopsia	0.015	0.175	30
Gilbert	Precipitation with sulphosalicylic acid; turbidimetry with with naked eye	Not stated	Tabetic optic atrophy	0.0125	0.116	10
		Not stated	Recent central choroiditis	0.016	0.100	10
Mestrezat and Magitot	Precipitation with trichloracetic acid; turbidimetry with with naked eye	Novocaine	Postneuritic optic atrophy	R.E. 0.010	0.025	180
		Novocaine		L.E. 0.010	0.150	60
		Novocaine		R.E. 0.010	0.085	60
		Novocaine	Postneuritic optic atrophy	0.010	0.075	60
				0.010	0.200	40
		Novocaine	Tabetic optic atrophy	0.012	0.050	25
				0.015	0.120	30
		Novocaine	Tabetic optic atrophy	0.023	0.070	30
		Novocaine	Tabetic optic atrophy	0.030	0.110	45
		Novocaine	Tabetic optic atrophy	0.023	0.240	45
Dieter	Determination of surface tension	Not stated	Aphakia	0.010	0.062	73
		Not stated	Senile cataract	0.014	0.080	60
		Not stated	Senile cataract	0.024	0.070	61
		Not stated	Senile cataract, diabetes	0.018	0.083	48
Franceschetti and Wieland	Precipitation with sodium sulphosalicylate; nephelometry	Cocaine	Senile cataract	0.021	0.097	23
		Cocaine	Senile cataract	0.034	0.086	30
		Cocaine	Senile cataract	0.027	0.070	15
		Cocaine	Senile cataract	0.030	0.140	15

through the bulbar conjunctiva) into the anterior chamber. In order to prevent fistulation, the corneal canal was made from 2 to 3 mm. long (projected onto the anterior surface of the cornea). Very gentle pressure exerted on the needle was usually sufficient to pierce the cornea. During this process the cornea became from 15 to 30 seconds. The anterior chamber was entered with only the tip of the needle, which was kept close to the posterior surface of the periphery of the cornea, so that it was only toward the end of the complete aspiration that a small portion of the ciliary zone of the iris came in contact with the needle. This

contact took place slowly and gently. The needle was not carried around the anterior chamber to aspirate the last bit of aqueous. Thus, even in "complete" anterior chamber punctures, traces of fluid, which probably did not exceed 0.01 c.c., were left in the anterior chamber.

kept in the refrigerator at a temperature of +6°C. for several months. Its protein content was checked about once a month by determining the protein-nitrogen content gasometrically. In calculating the protein content of the aqueous the assumption was made that 1 mg. of aqueous protein

TABLE 2

THE PROTEIN CONTENT OF THE GENUINE AND OF THE RE-FORMED AQUEONS IN NORMAL EYES

Hospital or O.P.D. Case Number	Age Sex	Eye	Clinical Diagnosis	Corrected Vision	Date of ACP	Volume of Anterior Chamber in c.c.	P_1 mg.%	Interval in Minutes	P_2 mg.%
53949	19 M.	R.	Cicatricial trachoma, normal eyeballs	6/10 Jg. 1	12-22-36	0.25	17.8	72	67
363813	16 M.	R.	Comp. myopic astigmatism	6/10 Jg. 1	5-26-38	0.45	8.2	31	45
52555	19 M.	R.	Exotropia	6/6 Jg. 1	9-18-36	0.27	9.4	50	120
54030	30 M.	L.	Exotropia	6/15 Jg. 1	4-18-36	0.40	15.4	65	470
58469	18 M.	R. L.	Exotropia	6/6 Jg. 2 6/6 Jg. 1	2-18-37 3-15-37	0.30 0.26	13.7 15.3	64 60	500 420
57279	17 M.	R.	Esotropia	6/6 Jg. 1	1- 5-37	0.22	14.2	75	220
368890	14 M.	L.	Esotropia Amblyopia	Finger-counting at 2 meters, Jg. 7	2-22-37	0.22	10.3	65	150

The protein content was determined by measuring the turbidity produced by the addition to the aqueous of sulphosalicylic acid, following the modification by Franceschetti and Wieland[11] of a method originally devised by Rona and Kleinmann. The turbidity produced in the aqueous was measured by comparing it, by means of the compensation colorimeter of Leitz with the attachment for nephelometry, with the turbidity produced in a standard protein solution. In the experiments reported herein, horse serum provided by the National Bureau for the Prevention of Infectious Diseases in Peiping served as standard. This serum contained thymol as a preservative and had been

produces the same degree of turbidity as 1 mg. of protein in the horse-serum dilution. This assumption is not altogether correct.* For the time being the figures for the protein content of the aqueous given in this paper should, therefore, be regarded only as relative and not as absolute values although in several patients with high p_2 values the results of the nephelometric method we found to check well with the results of the colorimetric (determination of tyrosine) method of H. Wu and S. M. Ling (Chinese Journal of Physiology, 1927, volume 1, page 161).

* Unpublished work which at present is being extended.

Material

The data in the following case reports refer to Chinese patients seen in the outpatient department or hospital of the Peiping Union Medical College. For purposes of description they can be divided into three groups:

Group A. This group consists of patients whose history, physical examination, and laboratory findings revealed no signs of any systemic illness, nor was there any evidence of any active organic disease in any part of their eyes. These patients appeared to be suitable as normal controls for the purpose of this study. The findings in these cases are given in table 2.

Group B. This group is made up of patients suffering from a form of retrobulbar neuritis that is common in China. The clinical characteristics of this disease have been given elsewhere.[12] It may suffice here to state that the disease is bilateral, and that it occurs in adolescents and young adults who have for years been subsisting on a qualitatively deficient diet. The onset is gradual. The principal ocular manifestation is the presence of small central scotomas. In exceptional cases the discs are slightly hyperemic for the first few weeks of the disease. Usually the fundi remain normal until temporal pallor sets in. The disease runs a chronic course with remissions and exacerbations that manifest themselves as fluctuations in the visual acuity and in the size of the scotomas. The prognosis of the untreated disease is favorable, inasmuch as the ultimate vision is rarely less than 0.1. While the evidence is not yet conclusive, it is probable that this form of chronic retrobulbar neuritis represents a deficiency disease caused by lack of vitamin B_1. We have often noticed definite improvement in vision in such cases immediately after the ACP. These observations have become so frequent that we felt it justifiable to recommend the employment of ACP as a therapeutic measure. Whether or not these cases may be considered as normal controls for the purpose of this study is a subject for conjecture. The protein content of the genuine aqueous in these cases has been found to be within normal limits.

Case reports

Hospital Case No. 56738. A Chinese male, aged 15 years, an apprentice in a needle factory, complained of a bilateral disturbance of central vision, without any other symptoms, of five months' duration. The onset had been gradual. The patient had been on a qualitatively deficient diet for two years. On admission the vision of each eye consisted of the ability to count fingers at one meter (no Jaeger). There were absolute central scotomas of 5-degree radius for 6/1,000 white targets. The temporal halves of the discs were pale. A thorough general examination revealed no other pathologic findings. Despite the addition of large doses of vitamins B and C to the patient's food and repeated ACP's, his eye condition remained stationary.

Hospital Case No. 56678. A Chinese male, aged 17 years, an apprentice in a printing shop, had been receiving qualitatively deficient and very monotonous food for one and one-half years. One month before admission to the hospital, a disturbance of central vision had been noticed. There were absolute central scotomas of 2-degree radius for the 4/1,000 red target, and the vision was 6/60, Jaeger 5, in each eye. The discs were slightly hyperemic. The maxillary sinuses were clouded. The presence of a few stippled erythrocytes in the blood and of a small amount of lead in the urine suggested chronic lead poisoning. The treatment consisted of punctures and irrigations of the definitely diseased maxillary sinuses, of deleading, and of the addition of large amounts of vitamins A, B, and C to the patient's diet. Within three months the vision improved gradually to 6/15, Jaeger 1, in each eye, the central scotomas disappeared, the fundi became normal, and the lead disappeared from the urine. While there were several possible etiologic factors present in this case, we considered the dietary deficiency the most probable factor.

Hospital Case No. 57520. A Chinese male, aged 20 years, on admission on January 30, 1937, complained of gradual reduction of the central vision of both eyes of two months' duration. Vision R.E. was 6/60, Jaeger 4; L.E. 6/20, Jaeger 3. The discs appeared to be normal, but there were absolute central scotomas of 3-degree radius for the 1/250 white target. A thorough general examination revealed a

chronic hyperplastic rhinitis and a chronic mastoiditis on the left side.

During the first month in the hospital (February, 1937) the patient's nose was given conservative treatment and several ACP's were performed. On February 25, 1937, the condition of both eyes had improved (vision R.E. was 6/20, Jaeger 2; L.E. 6/15, Jaeger 1), and the scotomas had become relative for the 1/250 white target. The temporal half of the right disc exhibited a questionable degree of pallor. On March 19, 1937, a simple mastoidectomy was performed. Granulation tissue and pus were found in the antrum. The removal of this focus of infection had no immediate effect upon the ocular condition. During May and June of 1937, however, without any further treatment, vision and the visual fields showed further improvement. On June 20, 1937, the eye findings were: vision R.E. was 6/10, Jaeger 2; L.E. 6/6, Jaeger 1; central scotomas barely demonstrable for colors; fundi normal.

Hospital Case No. 60810. A Chinese male who had been a soldier for 11 years was admitted to the neurological service on November 1, 1937, because of coldness, weakness, and numbness of both legs of one year's duration, during which time also hemeralopia and a disturbance of central vision had developed gradually. During a three months' stay in the hospital the diagnosis of polyneuritis due to lack of vitamin B was established, and the systemic disease was greatly improved by dietary measures. On admission, vision was R.E. 6/60, Jaeger 6; L.E. 3/60, Jaeger 7. There were small central scotomas with peripheral contraction for red, and pronounced hemeralopia. The fundi were normal. During the patient's stay in the hospital the ocular condition gradually improved. At the time of the ACP's the vision was 6/15, Jaeger 2-3, in each eye, the red fields had widened, and the dark adaptation had improved. The central scotomas were no longer demonstrable. Nevertheless, in June, 1938, a slight degree of temporal pallor without evident central scotomas and without any further loss of vision was noted.

Hospital Case No. 58931. A Chinese male, aged 24 years, a rug-weaver by profession, first noticed in February, 1937, a bilateral disturbance of central vision of very gradual onset without any other symptoms. For several years his food had been qualitatively deficient and his diet very monotonous. On admission (May 17, 1937) his vision was 6/20, Jaeger 4, in each eye. The fundi were normal. There were relative central scotomas of 1-degree radius for the 1/330 white target. The general examination revealed no significant findings. The patient received fever treatment (typhoid vaccine intravenously), acetylcholine injections, and vitamin-B preparations by mouth. On June 13, 1937, he left the hospital with his condition unchanged. At home he continued to use the vitamin-B extract for several months. At the time of the ACP's he had completely recovered from his retrobulbar neuritis, his vision being 6/6, Jaeger 1, in each eye.

O.P.D. Case No. 364304. A male Chinese student, aged 18 years, came to the out-patient department first on November 25, 1936, complaining of a disturbance of central vision in both eyes of one month's duration. He had been living in a boarding house on qualitatively deficient food. Normal fundi, a corrected vision of 6/20, Jaeger 3, in each eye, and central scotomas were found. No foci of infection were discovered. The neurologic findings were normal. Under vitamin-B therapy the vision gradually improved.

O.P.D. Case No. 389674. A Chinese male, aged 18 years, first presented himself in the eye clinic because of a bilateral disturbance of central vision of about nine months' duration. Vision R.E. was 3/50, Jaeger 7; L.E., the ability to count fingers at two meters. Both discs presented a picture of primary optic atrophy. There were absolute central scotomas of 12-degree radius for the 10/1,000 white target; the periphery of the visual fields was normal. The cause of the optic atrophy could not be determined (neurologic and rhinologic examination and Wassermann test negative). After several ACP's there was slight improvement in the vision.

O.P.D. Case No. 407631. A Chinese male, aged 20 years, first came to the Peiping Union Medical College on January 3, 1939, complaining of blurring of vision of three months' duration. The vision was 6/50, Jaeger 5, in each eye, and the refraction was emmetropia. There were centro-coecal scotomas combined with temporal pallor. The patient gave no definite history of nutritional deficiency. Medical, neurologic, and ear, nose, and throat examinations revealed no significant findings. After several ACP's the vision improved. Because of the marked difference between p_2 in his right eye and that in his left eye, the patient was studied carefully for structural and functional differences between his two eyes, but none could be discovered. His pupils remained equal upon instillation of sympathico-mimetic drugs.

Group C. The 10 patients belonging to this group showed far-advanced stages of bilateral primary optic atrophy with a visual acuity of less than the ability to count fingers at three feet. Cases 66556 (male, aged 50 years) and 66461 (female, aged 48 years) had tabes, whereas in case 66640 (female, aged 22 years) the cause of the optic atrophy could not be determined.

Results

In the cases belonging to group A (table 2), the values for p_2 in the fluid obtained from 31 to 75 minutes after the first ACP varied from 45 to 500 mg. percent. These results were essentially the same as those reported by Wessely, Gilbert, Mestrezat, and Magitot, Dieter, Franceschetti, and Wieland (table 1). P_2 was higher than p_1 in every instance,* but the difference was so small in the first two cases listed in table 2, that, as Wessely (*loc. cit.*) first pointed out, a less-accurate method of protein determination, like the refractometric one, might not have indicated any difference at all. Considering the fact that the intensity of the hypertensive phase and the rate of re-formation of aqueous after ACP in patients of the type presented in table 2 vary only slightly, the wide variations of p_2 seemed worthy of further analysis.

The question arose whether, in studies of this type, repeated p_2 determinations were permissible; that is, whether the reaction of the eye to the ACP was modified by repeated ACP's. If determined on the same eye at intervals of not less than three weeks and with strict adherence to the standard technique described herein, p_2 varied within ±15 percent of the average for the respective eye (table 3), and was not consistently higher or lower at the time of the second or third determination than at the first determination. With regard to the time that should elapse between the repeated p_2 determinations, we used the protein content of the genuine aqueous humor—p_1—as an indicator. We found** that p_1 had, as a rule—three weeks after two ACP's, made one hour apart—returned to the original level, which fact we interpreted to indicate that the eye had returned to the status quo.†

TABLE 3

REPEATED P_2 DETERMINATIONS

Hospital or O.P.D. Case Number	Eye	Date of ACP	P_1 mg.%	Interval in Minutes	P_2 mg.%	Average P_2 for Each Eye	Observed Variations of P_2 in % of Average
56738	L.	1- 5-37 2-25-37 4-23-37	9.2 9.5 9.0	70 62 64	51 56 54	54	± 6
56678	R.	1-21-37 4-23-37	12.4 13.0	65 60	318 314	316	± 1
407631	R.	2- 8-39 3- 8-39 6- 9-39	9.1 7.2 8.6	60 60 60	278 256 268	267	± 8
	L.	2-22-39 6- 2-39	13.0 16.0	60 60	59 80	70	±15
66556	R.	12-23-38 2- 3-39	14.2 11.3	60 60	30 40	35	±14
66640	R.	11-21-38 12-21-38	7.5 9.3	60 60	950 1000	975	± 3
	L.	12-28-38 5- 5-39	11.1 11.6	60 60	711 600	655	± 9

* With the only exception of eyes with active uveitis, we have not found a single human eye in which p_2 was not at least twice as high as p_1.

** These data will be published elsewhere.

† More recent studies have shown that this interval can safely be shortened to two weeks.

Redeterminations of p_2 in the presence of an abnormally high p_1—that is, before p_1 had returned to its normal level—yielded considerably lower p_2 values than the normal average for the particular eye. It was, therefore, the consistency of the p_1 as well as that of the p_2 values obtained by repeated ACP's on the same eye which led us to believe that repeated ACP's are permissible for a study of the factors which influence p_2. By the same token, we discarded the observations made on two patients in whom, after five double ACP's in both eyes, gross deviations from the expected consistency occurred.

The data contained in table 3 indicate the probable range of variations of p_2 as they occur in the same eye if the standard technique of the ACP is adhered to. With these data as a basis, we proceeded to determine the effect of variations in the technique of the ACP. The following factors seem to be worth considering:

1. The anesthetic.
2. The amount of fluid aspirated.
3. The irritation of the iris by the needle.
4. The speed of the aspiration.
5. The time interval between the two ACP's.

The anesthetic. The significance of the anesthetic used before the ACP was first demonstrated by Wessely (*loc. cit.*) and confirmed by us in previously reported studies,[13] in which the effects upon the protein content of the re-formed aqueous of cocaine, on the one hand, and of pontocaine or butyn, on the other hand, were compared (table 4). In the cases reported in this paper no further effort was made to determine the part played by the anesthetic. The only anesthetic used before the ACP's was pontocaine. It should be kept in mind that the observations reported here pertain to eyes that were under the influence of pontocaine. Until we shall be able to define this influence more clearly, the strong possibility of its modifying—although in this series in a constant and uniform way—the protein content of the re-formed aqueous should not be overlooked.

TABLE 4

THE EFFECT OF THE ANESTHETIC

Patient				Aqueous		
Hospital or O. P. D. Case Number	Age	Clinical Diagnosis	Eye	P_1 mg. %	P^2 mg. %	Anesthetic
55600	20	Retrobulbar neuritis	L.	7	270	Butyn
			L.	8	37	Cocaine
			R.	8	149	Butyn
			R.	12	54	Cocaine
55834	16	Nutritional edema, normal eyes	R.	6	181	Pontocaine
			R.	6	22	Cocaine
55620	22	Retrobulbar neuritis	R.	11	122	Pontocaine
			R.	11	69	Cocaine

Other Factors Related to the Technique of the ACP. The grasping of the bulbar conjunctiva with forceps and the puncture of the cornea in themselves exert no appreciable influence on the protein content of the aqueous.

In case 364304, in which the average p_1 was 14 mg. percent, on June 14, 1938, the

cornea of the left eye was punctured in the typical manner, but only 0.01 c.c. of aqueous was aspirated and immediately reinjected into the chamber, whereupon the needle was withdrawn without any noticeable loss of fluid. This puncture of the cornea caused a drop in tension from 15 to 13 mm. Hg. Thirty minutes later the anterior chamber was emptied by a typical ACP. The protein content of the fluid thus obtained was 15.3 mg. percent. The same experiment was carried out in case 389674, furnishing a fluid containing 16 mg. percent protein, whereas the genuine aqueous obtained on another occasion contained 15 mg. percent protein. Thus it was shown that the grasping of the bulbar conjunctiva with forceps, combined with simple puncture of the cornea, does not raise the protein content of the chamber fluid.

Amount of Fluid Aspirated. If a considerable portion (up to 75 percent) of the chamber contents was withdrawn and reinjected 10 seconds later, no increase in protein content occurred. If, however, one fifth or more of the chamber contents was withdrawn and not reinjected, the protein content of the aqueous rose above the level of p_1 (table 6). These modifications of the ACP differed principally with regard to the degree and the duration of the hypotony that followed the ACP. If the intraocular pressure was lowered only very slightly or for a short period, no increase in protein content occurred, whereas an ACP followed by a marked hypotony caused a considerable rise in protein content. Thus a relationship between the degree and the duration of the hypotony, on the one hand, and p_2, on the other hand, became manifest. *A priori* it had seemed logical to assume that the hypotony constituted the direct cause of the circulatory disturbance and of the rise in protein content. On this assumption Poos based his concept of the ACP representing a "hypotony trauma."

TABLE 5

COMPARISON BETWEEN COMPLETE AND SLIGHTLY INCOMPLETE ACP's

Hospital or O. P. D. Case Number	Date of ACP	Volume of Aqueous Withdrawn at First ACP	Emptying of Chamber, Complete or Incomplete	Contact with Iris	P_1 mg. %	Interval Minutes	P_2 mg. %
56738 R.E.	2- 1-37	.26	Complete	+	9.4	60	85
	3-30-37	.20	Incomplete	−	7.5	59	90
56678 R.E.	1-21-37	.23	Complete	+	12.4	65	318
	4-23-37	.23	Complete	+	13.0	60	314
	3- 6-37	.19	Incomplete	−	12.5	60	412
364304 L.E.	5- 4-37	.21	Complete	+	16.0	58	267
	3-19-37	.15	Incomplete	−	16.3	64	279

Studies on the relationship between p_2 and the hypotony caused by ACP are rendered difficult by the fact that after complete ACP's the intraocular pressure usually drops to, and remains for some time at, a value below the range of the Schiötz tonometer. Because of the direct relationship between the hypotony and the amount of fluid withdrawn, we have relied more on accurate measurements of the latter than on those of the former.

P_2 values obtained after ACP's in which the amount withdrawn was varied are given in tables 5 and 6. According to table 5, there is no significant difference between p_2 after complete ACP's and p_2

TABLE 6

COMPARISON BETWEEN COMPLETE AND INCOMPLETE ACP's

A Number of Patient Date of ACP	B Tension Before First ACP mm. Hg	C Volume of Anterior Chamber c.c.	D Amount Aqueous Withdrawn at First ACP c.c.	E Tension Immediately After First ACP mm. Hg	F Interval Between First and Second ACP minutes	G Tension Immediately Before Second ACP mm. Hg	H Amount of Protein in Genuine Aqueous mg.	I Protein in Anterior Chamber After Partial ACP mg.	I-H mg.	J Protein in Anterior Chamber After Complete ACP mg.	J-H mg.	$\frac{I-H}{J-H}$	$\frac{D}{C}$
60810 R.E.													
5-17-38	17	—	.058	4	30	17	.033	.243	.210	—	—	.62	.286
5-31-38	17	.203	.203	below 4	31	4	.033	—	—	.370	.337	—	—
58931 R.E.													
4-28-38	19	—	.063	5	30	20	.035	.146	.111	—	—	.32	.243
5-24-38	19	.259	.259	below 4	30	4	.035	—	—	.379	.344	—	—
364304 L.E.													
5-10-38	17	—	.050	6	30	17	.038	.268	.230	—	—	.25	.186
5-24-38	15	.268	.268	below 4	30	below 4	.038	—	—	.965	.927	—	—
389674 R.E.													
4-27-38	18	—	.050	5	32	17	.050	.233	.183	—	—	.16	.161
5-12-38	20	.310	.310	below 4	30	6	.050	—	—	1.170	1.120	—	—

after ACP's in which only from 70 to 80 percent of the chamber contents were withdrawn ("20-30 per cent incomplete ACP's").

Since the typical complete ACP entailed a certain amount of *irritation of the iris* by the contact with the needle at the end of the ACP, which contact has been shown to raise the protein content of the aqueous in laboratory animals, the data contained in table 5 also suggest that mere touching of the iris has no significant effect upon p_2.*

If only one third or less of the aqueous is removed, the resulting p_2 differs considerably from that obtained after complete ACP. In table 6 four such cases are listed in which the degree of hypotony after the partial ACP's was approximately the same. After these partial ACP's, a considerable amount of genuine aqueous remained in the anterior chamber whereby the proteins that leaked into the chamber in the course of the reactive processes were diluted to a varying degree. In table 6, therefore, not the protein content of the chamber contents in milligrams percent, but the absolute amounts of protein in milligrams present in the anterior chamber after partial (column I) and after complete (column J) ACP are presented. From these amounts the amounts of protein present in the genuine aqueous (H) were subtracted and thus the amounts of protein whose appearance in the anterior chamber was due to the reactive processes elicited by the ACP (column I-H and J-H, respectively) were obtained. The quotient $\frac{I-H}{J-H}$ thus expresses the protein inflow into the anterior cham-

* If, however, the contact with the iris was unduly harsh or prolonged, or if the tip of the needle became caught in the iris, the resulting p_2 was much higher than after the ACP's made according to the standard technique. Irritation of the iris does, therefore, exert an influence on p_2.

ber due to the reactive processes elicited by the partial ACP as a fraction of the protein inflow which occurs—in the same eye—due to the reactive processes elicited by the complete ACP. Quotient $\frac{I\text{-}H}{J\text{-}H}$ should, therefore, be an indicator of the relative effectiveness of partial punctures, and be uninfluenced by differences in reactivity between different individuals. Table 6 shows that the larger the portion of the chamber contents withdrawn (column $\frac{D}{C}$), the greater was the quotient $\frac{I\text{-}H}{J\text{-}H}$. Thus, in the human eye p_2 is dependent upon the portion of the chamber contents that has been withdrawn or, in the terms used by Wessely who originated this concept, upon the ratio:

$$\frac{\text{volume of fluid aspirated}}{\text{volume of eyeball}}$$

Table 6 also shows that the quotient $\frac{I\text{-}H}{J\text{-}H}$ tends to increase faster than the quotient $\frac{D}{C}$. Thus it becomes understandable why for $\frac{D}{C}$ of 0.75 or higher the quotient $\frac{I\text{-}H}{J\text{-}H}$ is in the neighborhood of 1, or, in other words, why slightly incomplete punctures yield a p_2 that is not essentially different from a p_2 after complete ACP (table 5).

The *speed of the aspiration* was intentionally varied in three patients and found to have no influence on p_2. With regard to the *interval of time* between the withdrawal of the genuine aqueous and that of the re-formed aqueous, we found that the protein content of the fluid present in the anterior chamber 10 minutes after removal of the genuine aqueous did not differ significantly from the protein content of the fluid obtained from the anterior chamber 60 minutes after the first ACP (table 7). These findings suggest that during the period from 10 to 60 minutes after the first ACP, p_2 does not undergo significant changes. There is, therefore, no reason for assuming, as Hagen has done, that the first portion of

TABLE 7

THE INFLUENCE OF THE INTERVAL

Hospital or O.P.D. Case Number		Date of ACP	Volume of Fluid Aspirated at First ACP	P_2 mg. %	Interval Between ACP's Minutes
66640	R.E.	11-21-38	0.250	950	60
		12-12-38	0.232	1000	60
		3-20-39	0.258	963	10
	L.E.	12-28-38	0.238	711	60
		5- 5-39	0.217	600	60
		3-24-39	0.238	740	10
66556	R.E.	12-23-38	0.244	30	60
		2- 3-39	0.230	40	60
		3-22-39	0.250	52	10
66461	L.E.	11-15-38	0.249	182	60
		2- 3-39	0.232	162	10
407631	L.E.	2-22-39	0.212	59	60
		3-22-39	0.265	65	10

the regenerated fluid is derived from a source different from that of the fluid formed later on.

The Variations of P_2 in Different Eyes. In the two eyes of the same subject p_2 varied within somewhat wider limits than in the same eye, but only in case 407631 did these variations exceed ±30 percent of the average of the p_2 values in both eyes. Our material (table 8) was too small in amount to allow definite conclusions to be drawn in this respect, but it did suggest the existence, in some patients, of significant differences between the averages of the p_2 values for each eye. It may be a significant fact that the patients in whom such differences of the p_2 averages for each eye were present also showed a difference of the p_1 averages for each eye, the higher p_2 average usually being associated with a lower p_1 average and vice versa. This relationship between p_1 and p_2 applied only to the two eyes of the same patient and not to different patients.

The variations of p_2 that were encountered in different patients were much greater. In the control cases (table 2) the range of variations was from 45 to 500 mg. percent, or between 18 and 200 percent of 249 mg. percent, the average. The highest and lowest p_2 values that were encountered in this study were 1,000 mg. percent in case 66640, and 31 mg. percent in case 66556. The p_2 values of other cases of primary optic atrophy (group C), as well as the p_2 values in the cases of retrobulbar neuritis, varied within the same limits as in the control series. Thus, the variations of p_2 in different persons were doubtlessly of a much greater magnitude than were those occurring in the same individual. In an attempt to account for these variations of p_2, the following factors were considered:

A. Factors related to the clinical condition of the eye.

TABLE 8

COMPARISON BETWEEN THE AVERAGES OF P_1 AND P_2 FOR BOTH EYES OF THE SAME PATIENT

Hospital or O.P.D. Case Number	Average P_1 mg. %		Average P_2 mg. %	
	R.E.	L.E.	R.E.	L.E.
56738	8.5	9.2	88	54
56678	12.6	15.0	348	208
57520	12.9	11.8	325	360
407631	8.3	14.6	267	68
66640	8.5	10.7	971	724
66461	12.0	12.0	211	172

B. Ocular factors modifying the mechanism of the ACP.

C. Factors related to the nervous and humoral control of the vegetative reactions of the eye.

A. Clinically, the three groups—that is, the control cases, the cases of retrobulbar neuritis, and the cases of optic atrophy—seemed to be very homogeneous, without significant differences between the single individuals. Repeated determinations of p_2 in patients with retrobulbar neuritis revealed no recognizable relation between p_2 and the prevailing stage of the retrobulbar neuritis. It is, therefore, unlikely that in the particular case p_2 was markedly influenced by the retrobulbar neuritis or the optic atrophy from which the individual was suffering. Repeated careful examinations with the slitlamp and the ophthalmoscope revealed no evidence of even the mildest form of active or inactive iridocyclitis or choroiditis in any of the cases reported herein. Loss of the

parasympathetic innervation of the pupil (cases 66556 and 66461) had no discernible influence on p_2, the latter being very low in the first and moderately high in the second case.

B. The rate of re-formation of the aqueous and the rise of intraocular tension after ACP were found to be dependent upon the chamber volume, [3, 6] and variations of the former two features could be explained largely as being due to variations of the latter. The conclusion arrived at was that "the chamber volume may be considered a measure of the magnitude of the stimulus which the ACP constitutes for the eye."[6] With regard to p_2, the situation was different. Not only did p_2 vary within much wider limits than the rate of re-formation of aqueous and the rise of intraocular tension after ACP, but also the variations of p_2 failed to show any dependence upon the chamber volume. It could be asked whether there was any indication of a relationship between p_2 and the relative chamber volume; that is, the ratio: chamber volume to bulbus volume. The answer to this question probably is that there is reason to expect that the chamber volume varies in principle directly with, and therefore is a measure of, the bulbus volume. If we, however, go into the question of the probable variations of the bulbus volume in our cases and omit the two extreme variants, cases 54030 and 383813, it appears at least probable that the bulbus volumes did not differ from each other by more than 30 percent, because the refraction in the cases under consideration was emmetropia or slight hypertropia. Their absolute chamber volumes varied within ±20 percent of the average. Combining the shallowest chamber with the largest probable bulbus (7 c.c. + 30 percent), the relative chamber volume would be $\frac{0.20}{9.1} = 0.22$, whereas the combination of the deepest chamber with the smallest bulbus would yield $\frac{0.3}{7.0} = 0.43$. Thus, the greatest difference in relative chamber volume that was probably present in our cases was 1:2, whereas the p_2 actually varied within the limits of 1:5. We therefore consider it unlikely that the great differences in p_2 between the different individuals reported in this paper were wholly or largely due to differences in the volume of their eyeballs.

C. The nature of the reaction of the anterior uvea to the ACP is such that the appearance of acetylcholin in the re-formed aqueous had to be expected. In several cases Dr. H. C. Chang, of the Department of Physiology of the Peiping Union Medical College, determined for us the acetycholin content of the re-formed aqueous with a biologic method.[14] The results of these studies will be published in detail elsewhere. It may suffice here to say that there was no parallelism between the protein content and the acetylcholin content of the re-formed aqueous. In cases 66640 and 66556, for instance, which represented the upper and the lower extreme of p_2, the acetylcholin content of the re-formed aqueous was the same, that is, 0.04-0.05 gamma in 1 c.c. of aqueous.

Determinations of histamin in the re-formed aqueous might have thrown some light on this question, but for technical reasons such determinations have not as yet been made. We do not, at present, have sufficient data on patients with definite abnormalities of the sympathetic or parasympathetic innervation of the eye, but we hope to report such data in the near future. In view of the marked effect of cocaine on p_2, this seems to be the most promising direction for further work. Thus, we must assume the action of a still-obscure individual factor to account for the variations of p_2 in different eyes

and in different individuals. The actual existence of such variations we believe to have been shown conclusively.

Summary

The protein content of the re-formed aqueous (p_2) was determined on eyes that could be considered as normal controls, on eyes of patients with retrobulbar neuritis, and on eyes of patients with optic atrophy. P_2 was found to vary within ± 15 percent of the average of the same eye, within somewhat wider limits in different patients. The lowest p_2 found was 31 mg. percent; the highest, 1,000 mg. percent. The portion of the chamber contents which was aspirated and the anesthetic were found to have a marked influence on p_2, whereas the time interval between the first and second ACP—within the limits of from 10 to 60 minutes after the first ACP—had no noticeable effect. To account for the marked variations of p_2 in different individuals, a strong individual factor had to be assumed, the nature of which has not as yet been determined.

References

[1] Kronfeld, P. C. Arch. of Ophth., 1929, v. 1, p. 450.
[2] ———. Zeit. f. Augenh., 1930, v. 71, p. 48.
[3] ———. Arch. of Ophth., 1933, v. 9, p. 801.
[4] ———, and Lin, C. K. Chinese Med. Jour., 1936, v. 50, p. 1323.
[5] ———, and Lin, C. K. Trans. Amer. Acad. Ophth., 1937, v. 42, p. 262.
[6] ———, and Lin, C. K. Proc. Soc. Exper. Biol. and Med., 1938, v. 39, p. 259.
[7] Poos, F. Arch. f. Ophth., 1931, v. 127, p. 516.
[8] Hagen, S. Klin. M. f. Augenh., 1920, v. 64, p. 187. Ibid., 1920, v. 65, p. 643. Ibid., 1921, v. 66, p. 493. Ibid., 1921, v. 67, p. 259.
[9] Loewenstein, A. Klin. M. f. Augenh., 1920, v. 65, p. 654.
[10] Wessely, K. Arch. f. Augenh., 1921, v. 88, p. 217. Ibid., 1923, v. 93, p. 184.
[11] Franceschetti, A., and Wieland, H. Arch. f. Augenh., 1928, v. 99, p. 1.
[12] Lin, C. K. Chinese Med. Jour., 1936, v. 50, p. 1345.
[13] Kronfeld, P. C., and Lin, C. K. Proc. Soc. Exper. Biol. and Med., 1936, v. 35, p. 401.
[14] Lee, L. Y., and Chang, H. C. Chinese Jour. Physiol., 1937, v. 12, p. 492.

FUNCTION AND STRUCTURE OF THE EYE*

EDWARD JACKSON, M.D.
Denver, Colorado

John Hunter said, "Structure is the image of function." Evolution, striving for the structure that will best serve function, works through the slow processes of variation and heredity. It has made the human eye the most perfect form of eye in the whole animal kingdom. The eye reports upon the universe by converting light radiations into nerve impulses, to be stored in the central nervous system in conscious and unconscious memories. Dealing first with light radiations, it builds them into optical images capable of recording on a sensitive retina. This requires transparency in the optical media of the eye. No other tissue in the body has such transparency. In other animals the corneal transparency is not so nearly perfect.

Animal metabolism, built on the discovery of oxygen and its part in tissue life, has become a great branch of biochemistry, but it does not offer much as an aid to the understanding of the transparency of living tissues. Crystals and some chemical compounds throw some light on transparency, but little that applies to the cornea, aqueous, crystalline lens, and vitreous of the eye. We know that transparency depends on uniformity of the transparent substances, but the means by which this is attained in animal tissues and fluids is still chiefly unexplored assumption. There is very little to explain what has been observed by the ophthalmologist, using the ophthalmoscope. Some elements of body serum can be mixed with aqueous, without perceptible loss of transparency. The nutritive material of cornea, crystalline lens, and vitreous is all drawn from blood serum. Apparently transparency depends on the permeability to some substances of the transparent membranes—Bowman's and Descemet's in the cornea, the capsule of the crystalline lens, and Bruch's membrane of the choroid—and their impermeability to others.

We know that rupture of any of these membranes brings about loss of transparency. Other incidents cause opacity, but the method by which they do it is less evident. Because so little is known—and possibly so much unkown—the practice of ophthalmology, with respect to the transparency of the media, is restricted to narrow limits. The disturbance of conditions, understood only as the product of prolonged evolution and heredity, is not to be entered upon lightly.

That the only function of the lens capsule is to hold and protect the lens substance has been lightly assumed and acted upon. It would be more conservative to regard the whole group of transparent media, including their limiting membranes, as parts of one apparatus, closely associated with the securing of full transparency. There is no evidence to prove that the nutrition of the eye is safer, or as safe, when the capsule of the lens has been separated from its normal connections and removed from the eye. It is more reasonable to treat it with the same respect we have learned to have for the membranes of Bowman and Descemet. These transparent membranes seem essential to the transparency of the parts they protect; but we know very little of the method by which their protection is given, or how they differ from the capil-

* Read before the American Ophthalmological Society, at Hot Springs, Virginia, June 4, 1940.

lary endothelium, which extends an enormous variety of service to every tissue of the body.

Resilience of the optical media comes next in importance to transparency. The word "resilience" is derived from *resilir,* an old French word, meaning "to spring back." We know this quality best in the steel springs of watches, vehicles, and other mechanical contrivances. It means the power of recovery, of resuming the original shape or position after being bent, compressed, or stretched. Resilience is often observed in vegetable and animal tissues. It is most strikingly manifest in the substances of the crystalline lens and the cornea. The resilience of metals has received much attention from mechanical engineers, but has gone unnoticed by ophthalmologists. De Schweinitz, in his textbook, has mentioned resilient nystagmus, referring to the recovery movement of the eyes, but no other use of this word has been found in any work on ophthalmology. Dr. Thomas Young, the broad student of physics and medicine, regarded the crystalline lens as a type of muscle because the fibers were able to change their shape. Controversy as to the power of accommodation has quite ignored the property of resilience, although Helmholtz pointed out that in chemical composition the cornea resembled cartilage, and Fincham ascribed to the lens capsule a share in accommodation. The most generally familiar instance of physiologic resilience is in the cartilage of the external ear. The hair and nails present this form of elasticity in different ways.

Resilience is not incompatible with permanence of form. This may be illustrated by comparing the external ears of different people. The form remains practically constant throughout life, and it is remarkably preserved by heredity. Thus, it is possible to determine whether a couple is father and daughter, brother and sister, or husband and wife by the shape of their external ears. Using this one feature to decide the question many times, subsequent acquaintance with these persons has never revealed a mistake.

In the eye the resilience of structure is of great importance as regards optical function. In the literature we now have a large number of observations indicating that corneal astigmatism may be a family inheritance as much as the shape of the external ear. Since de Schweinitz, in 1891, pointed out that astigmatism "against the rule" was more common in later life, the accumulated evidence all goes to show that this change of astigmatism is brought about by increasing lens astigmatism. There is no greater tendency to changes of corneal astigmatism than there is to changes in the shape of the cartilage in the external ear. Permanence in the shape of the cornea is of enormous importance in determining and making permanent the refraction of the eye. It also—more than any other tissue—maintains the shape and optical proportions of the eye. Helmholtz pointed out that the chemical composition of the cornea resembled that of cartilage, but it does not appear that the greatest physicist of his time ever noticed the resilience of the cornea.

To me, appreciation of the resilience of the eye has come gradually, through experience and observations of cataract extractions. At first it seemed amazing that healing of the cataract incision, or of any corneal incision with a lance-headed knife, could be so exact and perfect. Observation of operations performed with the Graefe knife, where the incision was partly or wholly outside of the cornea, showed that there was no such tendency to accurate apposition of the flaps. Since a paper was read before this society in 1888 on "A new form of cataract knife," the cataract incision has been made entirely within the clear cornea.

In one case, in which careful measurement, both before operation and after extraction, showed a nucleus 8 mm. in diameter (the largest I ever encountered), the incision was extended into the sclera, as was done by Graefe in his "Modified linear extraction." Generally speaking, the result was good, but the permanent corneal astigmatism of 11 D. brought home the importance of the corneal resilience.

With the early use of a cataract knife, which, by one forward thrust, completed a smooth section of the cornea, with no tendency to drag the eyeball out of position (Transactions of the American Ophthalmological Society, 1888 and 1900), and made a smooth incision in the lens capsule, instead of tearing it to shreds, I wondered at the smooth healing of the corneal section. The fact that corneal resilience, if not interfered with, was sufficient to keep the wound in good apposition, was so astonishing that it was a long time before it was fully relied upon. It was hard to believe that the cornea was equal in resilience to a watch spring, which will bend back and forth thousands of times a day for years, and still remain a reliable recorder of time. The cornea is put to no such test as that, but the continual accurate performance of its optical function requires that it should maintain its shape and quickly return to normal when its shape is disturbed. Its resilience has been tested and found to be reliable—for so many years that it can be trusted with perfect confidence. This resilience is maintained by corneal metabolism; a metabolism that has been perfected through countless generations of evolution. The human cornea is the final result. None of the lower animals has a cornea so accurately adjusted as an optical instrument, nor so capable of maintaining its resilience and transparency through such a long period of time.

Those who have practiced the modified linear extraction of Graefe, and the many elaborations of it that have been made since Graefe's death, may find it difficult to rely upon the efficiency of the cornea in dealing with a perfectly smooth corneal incision. Yet the popularity and free use of the plane keratome incisions of the cornea are the most striking phenomena of modern literature. Judging the future by the past, one may safely predict that the reliability of corneal resilience will come to be recognized.

A similar belated recognition is that of the transparency and perfect harmlessness of the lens capsule. Since Graefe's time, when he was the recognized leader in ophthalmic surgery, rough treatment of the lens capsule has continued and tended to grow worse. In the 50 years since the anterior capsule was freely opened by the cataract knife and pushed out of the way by the emerging nucleus and whatever cortex was firm enough to adhere to it, I have never found any evidence to show that opacity of the anterior capsule caused impairment of vision. Shreds of torn capsule, becoming points of attachments for blood clots or other cellular débris, often interfere with vision after cataract extraction. In some cases the posterior capsule or the hyaloid membrane or adjoining layers of vitreous may furnish opacities that are to be treated by operations for aftercataract. But acceptance of the permanent transparency of the lens capsule may well follow recognition of the resilience of the cornea.

It was not strange that general surgeons, who were using sutures to close incisions in the skin, the abdominal fascia, the dura mater, the walls of the intestines, and incisions of the heart muscle, should believe that the cataract incision also required sutures. Henry W. Williams, in 1866, began to use corneal sutures to close the cataract incision; and in 1868 he reported to this Society his results in

44 cases. At that time he regarded his results as perfect successes in 80 percent of the cases, partial success in 10 percent, and failures in 10 percent. Since then the use of different kinds of sutures in operations on the eyeball has become a wide field for the invention of ophthalmic surgeons, instrument makers, and dealers in surgical supplies. I have never attempted to use a suture for a corneal stitch, in either a cataract incision or a traumatic rupture, and I have no regret for abstaining from such meddlesome surgery.

In one case of cataract extraction (a patient with thick, heavy lids and poor self-control), a bad prolapse of the iris occurred. The question naturally arose: Might not this have been prevented by a corneal suture? At that time the so-called "simple extraction" (extraction without iridectomy), was being practiced. The final judgment was that if iridectomy had been done no prolapse would have occurred. However, reopening the wound and excising the prolapse was followed by good result.

"Simple extraction" was often followed by some degree of prolapse or incarceration of the iris, and on that account extraction together with a small iridectomy was substituted. The suggestion of a small, upward iridectomy to facilitate expulsion of the lens nucleus was probably Graefe's most valuable contribution to ophthalmic surgery. The diffusion of light, which may be a serious impairment in some iridectomies, is entirely avoided by a slight drooping of the upper lid. The pupil thus obtained is, for all practical purposes, equal to the normal, round pupil. In elderly people the play of the pupil is sometimes more free after removal of part of the iris sphincter. In the paper of our fellow-member, Edward C. Ellett, on "The use of sutures in cataract extraction," we find the following statement: "I think it does give a relative insurance against prolapse, but there was still enough trouble from this source to lead me, after a rather extensive trial of the simple operation, to give up in favor of the combined operation; except in selected cases, where the cosmetic result was a thing to be considered."

Transparency of the cornea has become a matter of increased practical importance since the attempt was made to graft a portion of clear cornea in an eye made useless by corneal opacity. Such operations have demonstrated that the human cornea is the only practical source for such grafts. In the human cornea it is only the central portion that gives good vision. This part of the cornea is farthest removed from the vascular nutritive supply, is most dependent on the aqueous humor for its nutrition, and is best guarded from mutations in blood serum that might impair its transparency. The whole subject of corneal grafts must be considered from the viewpoint of preservation of corneal transparency and resilience.

The theory of corneal resilience throws a new light on the details of corneal structure, as these have been described by our histologists. The old view, which regarded the cornea and sclera as constituting one structure, the "tunica fibrosa," implied simply a container and protector for the inner coats of the eye. It is still perpetuated in the name "fibrous tunic," and the older descriptions of corneal structure.

When we regard the cornea as an essential part of a wonderful optical instrument, the significance of its histological structure helps us to understand its physiology. The young student very soon learns the difference between scleral and corneal histology. From what he sees with the microscope he quickly learns to know whether he is looking at sclera or cornea. The corneal structure, however, be-

comes clear and rational only when we understand the enormous importance of preserving the curve of its anterior surface gradually reached by evolution through countless generations of inheritance. The corneal lamellae—thin layers, all curved alike and closely united—constitute an ideal structure for resilience, especially when they are seen as broad thin bands crossing at different angles and made up of fine elastic fibres. Salzmann's description of the cornea, becomes more important and easier to understand when considered as a provision for resilience.

The layer of pigment epithelium developed with the retina, but often described with the choroid, still awaits explanation by a better understanding of its function. It has been regarded as a curtain, intended to keep down the general illumination of the eye; to render more distinct the focal image claiming the attention of its possessor. A little attention has been given this structure in connection with experiments on visual purple; but perhaps more can be learned about it as the result of the experiments described in the paper on "Aberrations of the eye," read before this Society at its meeting in San Francisco two years ago. The particular phenomenon bearing on this pigment lining of the vitreous chamber is the reflection occurring close to the anterior pole of the crystalline lens, causing radiating lines, extending from the central image of any bright object, as the sun, or a reflection of the sun from a polished surface of an automobile, through which light is distributed to all parts of the pigment-cell layer. This reflection of light from near the anterior pole of the lens furnishes illumination to this broad pigmented surface. This is readily observed by watching the radiations from the two headlights of an automobile as they come nearer, and thus furnish light to the eye from different directions. When we remember that in the vegetable world radiations from the sun, through the creation of chlorophyl, furnish all the food for green plants and the animals that live directly upon them, we can believe that light distributed to the layer of pigment epithelium in the eye may have a vital connection with the continued fitness of the eye for vision.

The retinal pigment layer has commonly been regarded as merely a dark curtain to exclude light that would diminish the distinctness of the retinal image. It does not entirely exclude even the light that enters the eye through the lids and sclera. This fact can be demonstrated as to the pupillary reflex. The amblyopia that attends deficiency of this pigment layer seems rather to indicate that the pigment has an extremely important function as to retinal metabolism. The separation of the retina from the pigment layer, commonly called detachment of the retina, is quickly followed by impaired retinal function, which may be restored partly by bringing the retina in close apposition to the pigment. It would seem that the intraocular pigment has a connection with vision somewhat similar to that which chlorophyl has with the production of plant food. As to this connection, the comparative physiology of the lower animals that seem to have the best vision is an important subject for investigation. Probably some assumptions as to the physiology of the human retina need careful and thorough reconsideration, and light may then be thrown on the function of the pecten in birds.

Republic Building.

CLINICAL STUDIES CONCERNING THE ALLEGED SYNERGISTIC ROLE OF BENZEDRINE AND PAREDRINE IN HOMATROPINE CYCLOPLEGIA*

WILLIAM F. MONCREIFF, M.D., AND KARL J. SCHERIBEL, M.D.
Chicago

This study was undertaken for the purpose of discovering whether or not Benzedrine sulphate (amphetamine)† (1-percent solution) actually increases the efficiency of homatropine cycloplegia. After the use of Benzedrine in a series of 25 patients, the drug paredrine† was studied in a similar way in another series of 25 patients, and finally, during the past year, a third series (of 33 patients) using paredrine, including in the comparison the rather conventional method of six instillations of 2-percent homatropine. In combination with these adrenergic drugs, a 5-percent homatropine solution was used, 2 drops being instilled, the first before, the second after the Benzedrine or paredrine. An interval of 5 minutes elapsed between instillations, and in all the Benzedrine cases, a preliminary surface anesthesia was secured by 3 drops of pontocaine. Careful technique was used in all instillations, with a strong downward fixation of the eye, placing a large drop at the upper limbus, and causing it to flow over the entire corneal surface from above downward. Forty minutes after instillation of the last drop, the examination was begun. For the sake of brevity the following abbreviations will be used:

HA = 5-percent homatropine alone, 2 drops
HB = 5-percent homatropine 2 drops, Benzedrine 1 percent, 1 drop
HP = 5-percent homatropine 2 drops, paredrine 1 percent, 1 drop
H2% = 2-percent homatropine alone, 6 drops

The basic plan was to subject each eye of each patient to successive examinations, allowing an interval of a week or more between stages. In series 1, or the Benzedrine series, the order in some patients was HB, then HA, in others HA, then HB, while in still others it was HB in the right eye, HA in the left, later HA in the right eye, HB in the left eye. In series 2 and series 3, the same principle of variation of the order of drug administration was used, except that H2% was always used as the third stage. These variations were introduced by way of attempting to balance the influence of any unknown extraneous conditions which might affect the depth of cycloplegia. In each instance, the refraction examination consisted of skiascopy, using the method of cylinders when applicable, followed by the subjective (trial case) test, and finally the so-called artificial myopia or residual accommodation test with the Prince rule. In the last 9 patients of series three, a fourth stage of examination was added, using 2 drops of 1-percent solution of paredrine only, the results of which are stated below. In series 2 and series 3, some accessory observations were made on the relative dilatation of the pupils, and the rate of recovery from cycloplegia, especially with reference to the accommodative status after 24 hours. However, we have not undertaken to make a full study of the possible role of Benzedrine or paredrine in shortening the duration of homatropine cycloplegia, and have concentrated primarily on investigating the efficacy of the cycloplegia.

We shall not undertake a full review of the literature on this subject, which is

* Read before the Chicago Ophthalmological Society, May 13, 1940.

† Some of the Benzedrine and paredrine used in this work was furnished by courtesy of the manufacturers, Smith, Kline, and French, at whose request the trade name of the drug is capitalized.

nevertheless not large, but refer only briefly to about half a dozen reports which have some bearing, either directly or indirectly, upon the main issue. Most of these have been published since we began our work on this problem two years ago. The majority of writers on this subject refer to a paper by Myerson and Thau,[1] published in July, 1937, in which a statement is made that instillation of a drop of 1 to 2,000 solution of atropine with 1 to 1,000 solution of benzedrine sulphate, within a few minutes produces marked dilatation of the pupil . . . , and "the accommodation of the lens disappears." In their conclusions, this statement is made to read "marked miosis (meaning mydriasis) and cycloplegia." No data nor evidence of any kind is presented in support of these statements.

Our attention was directed to this subject by a report by Beach and McAdams,[2] published in February, 1938. They examined a series of 25 patients, comparing the cycloplegic action of a single drop of 5-percent homatropine followed by Benzedrine with that produced by repeated instillations of 5-percent homatropine only in the same patients at a later time, after recovery from the first dosage. They do not state how many drops of 5-percent homatropine were used in the repeated instillations, but it is obvious that the quantity of homatropine dosage was quite different in the two instances; in other words, the action of one drop compared with the action of two or more, as far as the homatropine is concerned.

Sudranski[3] (October, 1938) reported studies on homatropine-Benzedrine cycloplegia in two series of patients. The comparisons were not, however, between equal dosages of homatropine. In the first series, comprising 25 patients, the depth of cycloplegia induced in one eye by a single drop of 5-percent homatropine and a single drop of Benzedrine was compared with that induced in the other eye of the same patient by repeated instillations of 5-percent homatropine, using 2 to 4 drops according to the age of the patient. The residual accommodation was found to be only a fraction of a diopter greater in the eyes receiving only a single drop of homatropine (and of Benzedrine), than in those receiving 2 to 4 drops of homatropine. The conclusion was stated that the single drop of homatropine, with a drop of Benzedrine, gives cycloplegia as efficient for practical purposes as that obtained by repeated instillations of homatropine. In a second series, comprising 15 patients, the effect of a single drop of 5-percent homatropine in one eye was compared with that of a single drop of 1-percent Benzedrine in the other eye. A week or more prior to these tests the same patients were examined by the routine method of 6 drops of 2-percent homatropine. Conclusions were that cycloplegia from a single drop of 5-percent homatropine was 90-percent as efficacious as that from the repeated instillations of the 2-percent solution, and that Benzedrine alone produced no cycloplegia at all. Sudranski concluded that Benzedrine has no synergistic action with homatropine in the production of cycloplegia, but only in the production of mydriasis.

Powell[4] (September, 1939) reported studies of Benzedrine-homatropine cycloplegia in 100 patients, comparing various dosages, and arriving at a standard of 4 drops of 2-percent homatropine for the homatropine-only method, and 2 drops of 2-percent homatropine followed by 2 drops of Benzedrine for the Benzedrine-homatropine method. Although this particular paper lacks definite data on the efficacy of cycloplegia secured by either or each of these methods, the author felt that satisfactory "practical cycloplegia" was produced by either method. He

seemed more interested in the conclusion that recovery was more rapid from the Benzedrine-homatropine method, a phenomenon which may well be explained by the fact that in these cases of quick recovery the dosage of homatropine was only one half the amount used in homatropine-only cases. Powell does not, however, offer this interpretation.

Marron[5] (February, 1940) reported extensive studies on cycloplegia and mydriasis with various drugs, and included a series of 25 patients examined under paradrine-homatropine administered as above described for our own studies. He found a minimum residual accommodation of 1.6 D., and practical recovery of near vision in six hours in most cases. No comparative data were offered with reference to the role of paredrine.

Weinman and Fralick[6] (February, 1940) reported studies on Benzedrine, paredrine, and cocaine, with homatropine, on an enormous number of patients, but do not appear to have made comparative studies on the same eyes or the same patients, using one series of patients for one combination of drugs and another series for another combination, and so on. Their Benzedrine-homatropine series comprised 731 patients. The drugs were combined in a single solution of 5-percent homatropine and 1-percent benzedrine, only a single drop being used in each eye. They found the minimum average residual accommodation by this method to be slightly less than 1 D., the peak of cycloplegia in 55 minutes, and that most of the cycloplegia had worn off in 7 hours. They called attention to the fact that in Negroes and some brunettes, 1 drop does not produce adequate cycloplegia, and from 2 to 6 drops are required. Paredrine-homatropine was used in a similar manner by these authors in a series of 281 patients, with findings only slightly different from those with Benzedrine-homatropine. The minimum average residual

TABLE 1

FACTORS INVOLVED IN THE STUDY OF BENZEDRINE AND PAREDRINE IN HOMATROPINE CYCLOPLEGIA

	Series 1	Series 2	Series 3	Totals
Number of patients	25	25	33	83
Number of eyes	50	50	66	166
Age factors: Range of ages	12 to 51	12 to 37	11 to 46	11 to 51
	no.	no.	no.	no.
Age 16 to 35	18 or 72%	13 or 52%	24 or 73%	55 or 66%
Age under 16	4 or 16%	10 or 40%	8 or 24%	22 or 26%
Age over 35	3 or 12%	2 or 8%	1 or 3%	6 or 7%
Color of iris (patients)				
Brown	4 or 16%	10 or 40%	11 or 33%	25 or 30%
Blue	21 or 84%	15 or 60%	22 or 67%	58 or 70%
Corrected vision (eyes)				
Less than 1.2	8 or 16%	3 or 6%	4 or 6%	15 or 9%
1.2–4 to 1.5	42 or 84%	47 or 94%	62 or 94%	151 or 91%
Refraction factors (eyes)				
Highest meridian over 3D.	8 or 16%	10 or 20%	10 or 15%	28 or 17%
Highest meridian over 1D.	26 or 52%	35 or 70%	38 or 58%	99 or 59%
Highest meridian 1D. or less	24 or 48%	15 or 30%	28 or 42%	67 or 41%
Over 1D. cylinder	8 or 16%	4 or 8%	3 or 5%	15 or 9%
Variations in refraction findings (eyes)				
Differences of over 0.25D.	5 or 10%	5 or 10%	12 or 18%	22 or 13%
Differences of over 0.50D.	2 or 4%	2 or 4%	2 or 3%	6 or 3%

TABLE 2

RESIDUAL ACCOMMODATION (166 EYES)

	1.25D.	1.00D.	0.75D.	0.50D.	0.25D.	Total
Series 1						
Benzedrine-Homatropine (HB)	0	3	9	24	14	50
5% Homatropine only (HA)	0	7	18	23	2	50
Series 2						
Paredrine-Homatropine (HP)	0	0	4	19	27	50
5% Homatropine only (HA	0	3	15	23	9	50
Series 3						
Paredrine-Homatropine (HP)	3	8	15	26	13	66
5% Homatropine only (HA)	2	10	22	30	2	66
2% Homatropine only (H2%)	0	8	18	29	11	66

accommodation by this method was slightly more than 1 D., the peak of cycloplegia occurred in 60 minutes, and recovery of near vision required about 8 hours. The effect of a single drop of 1-percent Benzedrine upon the accommodation was also studied by these authors. In the group of patients thus examined, it was found to reduce the accommodative power by an average of 3 D.; namely, from an average of 7.5 D. to 4.5 D. Thus Benzedrine is, according to these findings, a mild cycloplegic, quite insufficient in itself, at least in such small dosage, for adequate cycloplegia.

Our own studies were conducted on a total of 83 patients of the Central Free Dispensary at Rush Medical College, in three series, as previously noted. Only those patients were selected who met certain criteria of suitability for this work, chiefly as follows: (1) Sufficient intelligence and power of attention to respond adequately to the subjective tests, including the residual accommodation test; (2) eyes with good vision, usually normal, and free from lesions or defects other than ametropias, mostly relatively small in amount; (3) ability and willingness to submit to cycloplegia on two or more occasions within a few weeks.

Table 1 shows in each series the age groupings and other factors, including general color of iris, visual acuities, refraction groups on a quantitative basis, and the incidence of variations in refraction findings.

Table 2 gives an accurate comparative analysis of the residual accommodation in the 166 eyes studied in the various groups. It will be noted that the highest residual accommodation found by any method was only 1.25 D., and this in only 5 eyes, or 3 percent of the total. In fact, the residual accommodation was less than 1 D. in 73 percent of all the eyes studied, regardless of the combination or selection of drugs used. Further analysis of each group fails to reveal any striking practical superiority in the production of adequate cycloplegia by synergistic action on the part of either Benzedrine or paredrine over the same dosage of homatropine without these additional drugs.

Study of the action of paredrine alone (2 drops of a 1-percent solution) in the 9 patients previously referred to gives figures somewhat higher than those on Benzedrine reported by Weinman and Fralick; the dosage of paredrine was, however, twice that of Benzedrine. Accommodation was reduced as little as 2.5 D. or as much as 9 D., with an average of about 5.00 D.

The refraction findings with paredrine alone showed a shift toward the myopic end of at least 0.50 D. to more than 1.00 D. In this small group of patients, none

were over 21 years of age, all had normal corrected vision, and there were no high ametropias. The accommodative power of these patients ranged from 10 to 13 D.

In most of the 58 patients of the paredrine-homatropine series (2 and 3) the residual accommodation was tested 24 hours* after the induction of cycloplegia by HP and HA, and patients having been previously instructed to watch for the time of recovery of near vision reported their observation; uncorrected myopic eyes were of course not considered in this regard. Since we were not in a position to secure accurate data within the first 6 to 8 hours of recovery of near vision, such data as we have are not presented in detail. Suffice it to say that recovery of near vision, as reported by patients, occurred in about 8 hours in most cases, and that neither by this criterion nor by the state of accommodation after 24 hours did any definite superiority of the HP over the HA method appear as to rate of recovery.

In series 3, the size of the pupil to the nearest half millimeter was recorded in each method: HP, HA, and H2%. In only 8 cases was the pupil more widely dilated by HP than by HA or H2%. The maximum noted (in all cases) was 9 mm.

Summary and Conclusions

The clinical data here presented indicate that, within the age groups studied, adequate cycloplegia for the accurate determination of the total refraction is secured by the careful instillation of 2 drops of 5-percent homatropine as previously described. There are doubtless exceptions among children under 10 or 12 years of age, who nevertheless usually tolerate prolonged cycloplegia more readily than do adults. Patients with a very dark brown iris, especially those of dark races, are likely to require additional dosage for efficacious cycloplegia, as pointed out by Weinman and Fralick. This added dosage may naturally be expected to entail a slower recovery from the cycloplegia.

The data which we present do not indicate any superiority of the H2 percent method, nor do they lend support to the idea advanced by various workers above cited to the effect that Benzedrine and paredrine add materially to the efficiency of homatropine cycloplegia.

The question of a possible action of these drugs in shortening the duration of homatropine cycloplegia has not been adequately studied by us, and may warrant further investigation. However, the data submitted by other workers in support of this proposition are certainly open to the simpler interpretation that the rapid recovery reported was due to the reduced dosage of homatropine employed.

While our series of cases is not large, we believe that the careful selection of patients and the type of comparisons which we have made, warrant us in drawing the conclusions just stated, as well as the following more general conclusions; namely, (1) That most of us have been using a higher dosage of homatropine for cycloplegia in many cases than is actually required, and (2) that 2 drops of 5-percent homatropine will give adequate cycloplegia in most adults and many adolescents. We feel justified in recommending the more general adoption of this method, with the proviso that the residual accommodation be tested either as a routine, or certainly in all doubtful cases.

58 East Washington Street.
55 East Washington Street.

* The authors wish to express their thanks to Doctors Alfred Schultz, Vernon Voltz, and W. B. Butner, former residents at Presbyterian Hospital, for technical assistance rendered in making these tests.

REFERENCES

[1] Myerson, Abraham, and Thau, William. Arch. of Ophth., 1937, v. 18, July, p. 78.
[2] Beach, S. J., and McAdams, W. R. Amer. Jour. Ophth., 1938, v. 21, Feb., p. 121.
[3] Sudranski, H. F. Arch. of Ophth., 1938, v. 20, Oct., p. 585.
[4] Powell, L. S. Amer. Jour. Ophth., 1939, v. 22, Sept., p. 956.
[5] Marron, James. Arch. of Ophth., 1940, v. 23, Feb., p. 340.
[6] Weinman, E. B., and Fralick, F. B. Amer. Jour. Ophth., 1940, v. 23, Feb., p. 172.

ILLUMINATION STANDARDIZATION OF THE SNELLEN CHART*

HILMAR G. MARTIN, M.D.
Milwaukee, Wisconsin

To define a "normal" of physiological function, certain standards must be specified by which the measure is taken.

In testing visual acuity the use of the Snellen chart at 20 feet is generally accepted as a standard procedure. In other words, the minute angle alone governs this measure. It is not the purpose of this paper to analyze or defend this definition.

However, no definite standard of illumination of the standard test chart at the standard distance has been generally accepted, nor is there any intensity of illumination commonly specified to lend authoritative definition or set up a standard for common usage.

The recording of the results of visual-acuity tests should include specification of light intensity and quality as well as the minute-angle definition. Without such specification there can be no logical comparison of results, for this factor is variable, and no standard has been accepted. Just what that standard should be is of no particular moment, provided some specification is given as a basis of comparison.

To introduce the suggestion of standardization of illumination only the use of the printed Snellen chart at the standard distance will be considered here.

The mechanism of illumination must conform to certain conditions, such as: (1) Constant illumination of any desired and specified intensity, specified as to quality, which will not be altered upon change of the intensity; (2) sustained intensity over a long period of time without variability, but with the provision for varying the intensity at will to any desired amount; (3) duplication of identical conditions upon repeated and subsequent examinations.

Practically, two main factors must be kept in mind: (1) The intensity and quality of light, and the reflecting surface; (2) the percipient and interpretive mechanisms of the visual apparatus. Considered separately in a general way, Bragg[1] reminds us that a ray of light is specified completely, so far as the eye is concerned, when its intensity and wave length are defined. In any analysis we must be mindful of the fact that "white light" is a quality of our own definition, and that the source of light is the source of all colors in that light and contains the whole range of spectrum colors. The spectral analysis of daylight varies, as is well known, under varied circumstances. Therefore the quality of the artificial light used for the test must be specified to keep the standard pure.

Visual impressions of light depend upon the reactions of the visual apparatus in its entirety and are subject to individual variations. The ability of the normal eye

*Presented before the Milwaukee Oto-Ophthalmic Society, December 12, 1939.

to perceive and of the brain to interpret light waves is limited to a comparatively small range of wave lengths, and further limitations are imposed by various physiological as well as age factors. Abnormalities of the visual apparatus impose still further limitations of perception and interpretation.

The control of the intensity of illumination and its quality in the conduct of ex-

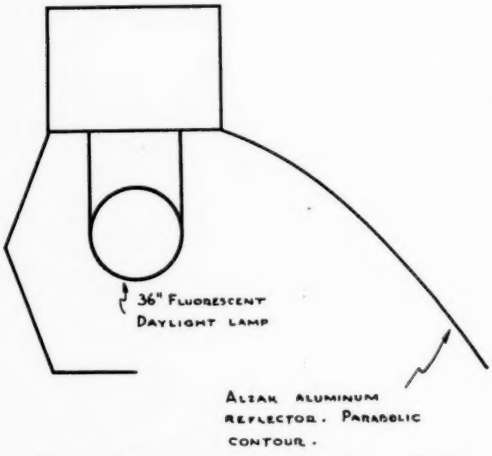


Fig. 1 (Martin). Cross section of reflector.

aminations has been stressed by Ferree and Rand.[2] They emphasize the variation in quality of light when the intensity is altered by means of a rheostat, and explain the mechanism of the attendant errors in refractive corrections. They point out the desirability of a variable illuminator in routine refractive practice.

Investigation of the lighting conditions of the patient's working environment must be investigated and approximated under conditions of test.

An apparatus is herewith presented that is simple in operation and satisfies the necessary requirements. It consists of two fluorescent-tube lighting elements, each 36 inches long. The reflectors are of special nature, incorporating the advantages of the cylindrical and parabolic reflection principles; the cylindrical to "point" the incident rays and the parabolic to project them upon the chart. The incorporation of the two permits maintenance of intensity, with equal distribution over the entire chart. The intensity can be varied and controlled at any desired level from 2 foot-candles to 500 foot-candles simply by approximating or drawing apart the lighting elements with their reflectors, for these are mounted upon the interlacing "X" extension and hinged upon an upright standard. The intensity is measured at any desired control level by a light meter contained in a box which also houses the transformers for the tube elements and the Worth 4-dot color spots, each controlled by separate switches.

The method of use is simple; the sources of light are adjusted to the de-

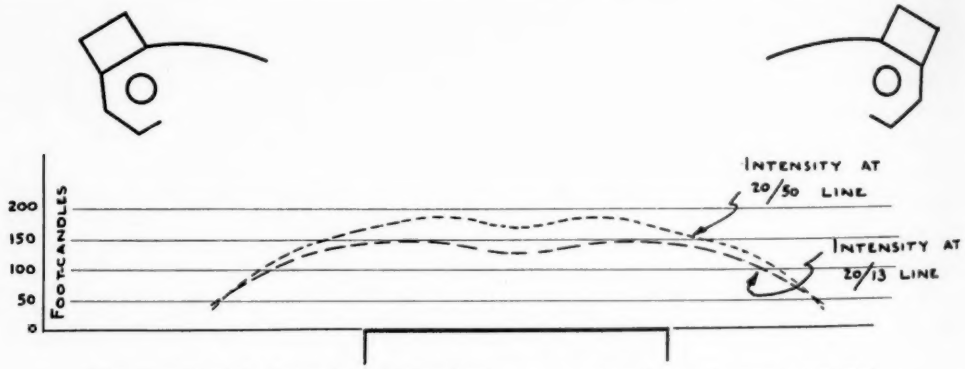


Fig. 2 (Martin). Intensity of illumination on vertical face of chart with 36-in. daylight fluorescent lamps.

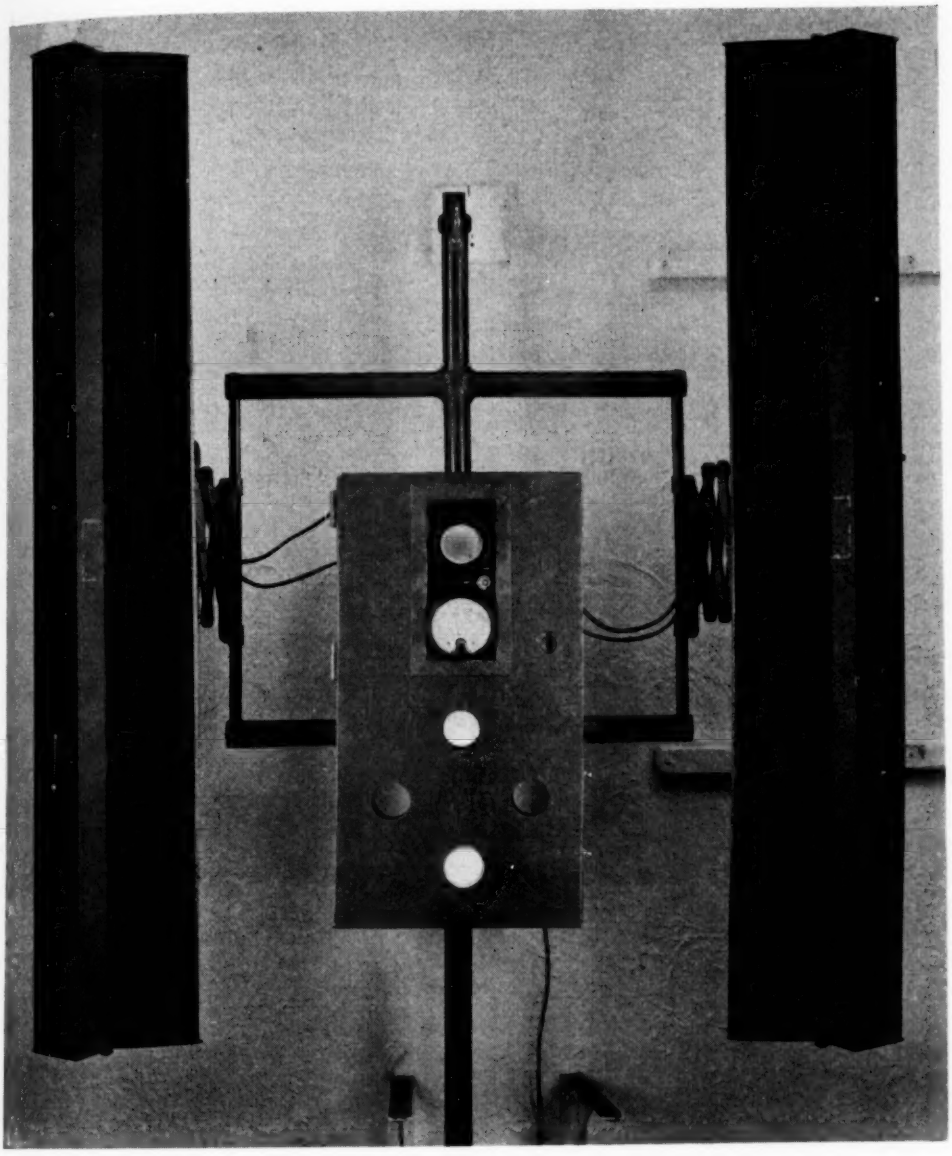


Fig. 3 (Martin). The reflectors, the light meter, and the 4-dot arrangement.

sired intensity, read on the light meter, and the charts are then fixed in place covering the box.

Figure 1 shows a cross section of the tube light and the partial cylindrical and parabolic reflectors.

Figure 2 shows the equality of intensity over the face of the chart at the level of the 20/50 and the 20/13 lines. The curve has a definite progression, but is exhibited here merely to demonstrate the even intensity obtainable and is not necessarily advocative of this intensity level for ordinary testing purposes.

Figure 3 shows the reflectors, the light meter, and the 4-dot arrangement. The re-

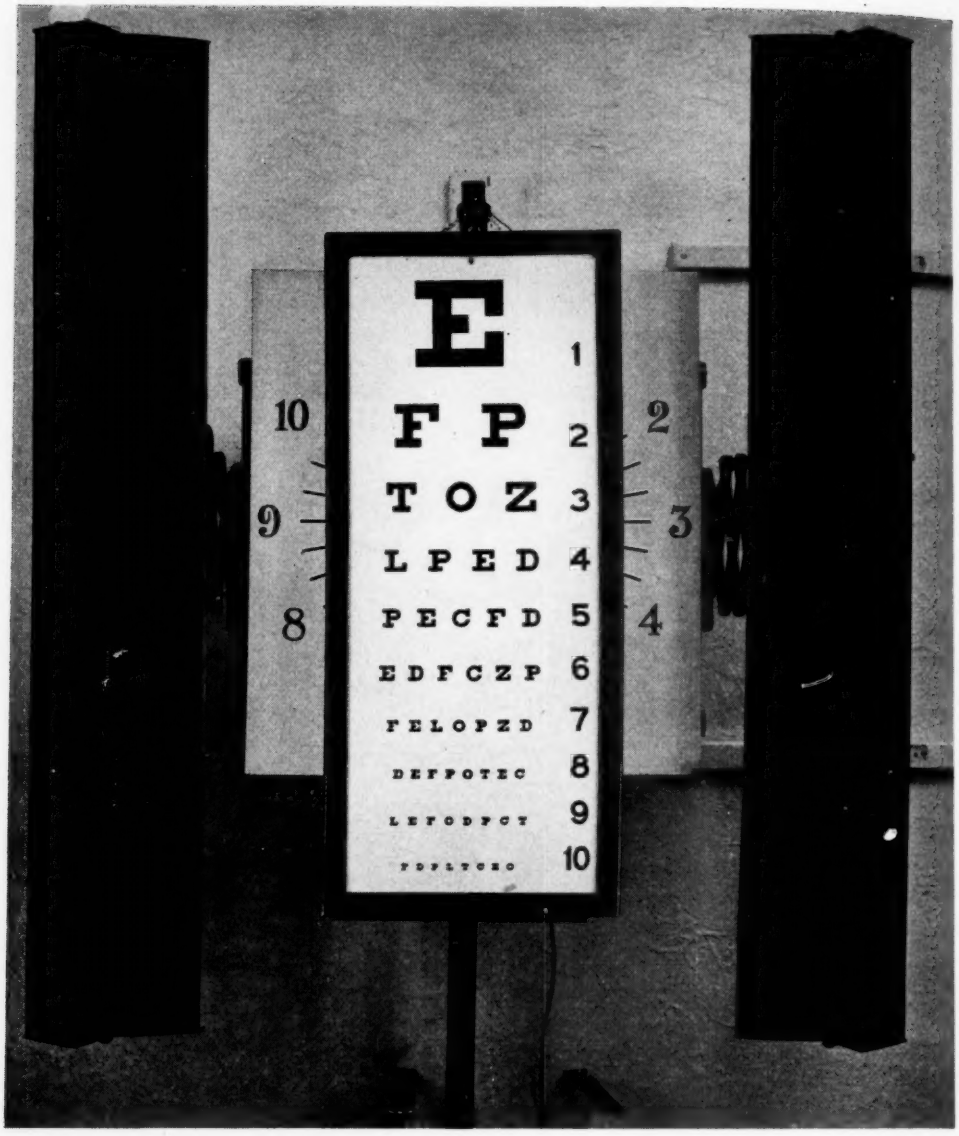


Fig. 4 (Martin). The charts in place.

flectors, upon the extension mounting, are withdrawn from or advanced toward the light meter until the desired illumination intensity is obtained. The charts are then hung in place as shown in figure 4.

It has been shown that visual acuity increases greatly from lower intensities up to 9 foot-candles, and that there is a decidedly limited and individual increment of increase of acuity above intensities of 100 foot-candles.

In a current series of tests, an intensity of 125 foot-candles is maintained, which does not mean that the eye is looking into a light source of this intensity. The reflecting surface of the chart indicates an intensity of 45 foot-candles on a portable light meter, and this intensity is main-

tained in all parts of the examining room as a maximum. This intensity is not advisable for routine refraction. While it is possible to achieve much higher intensities of illumination upon the chart by proper manipulation of the reflectors, it must be stated that the wattage of the two tube elements does not exceed 30. Since there are no filaments in the tube lights, decreased illumination intensities with prolonged use are not encoutered.

Low intensities of illumination are advisable in testing patients who have abnormalities of the refracting media, the shaper definition being supplied by the corrective lenses.

Conditions such as size of the pupil, age of the patient, abnormalities of the accommodative system, dark or light adaptation of the eye are not considered to be within the province of this discussion.

This apparatus has been presented as a means of obtaining a source of illumination of the standard chart at the standard distance, preserving a constant light intensity of any desired amount with unvarying quality.

Until a standard specification of light intensity and quality has been established and generally accepted in routine refraction practice, illumination intensity should be stated in recording visual acuity in order to provide some basis of comparison of results.

Exactly what the standard should be is a matter for further study and detailed effort.

231 West Wisconsin Avenue.

References

[1]Bragg, Sir William. The universe of light. New York, The Macmillan Co., 1933, p. 89.
[2]Ferree, C. E., and Rand, G. Testing of visual acuity. Amer. Jour. Ophth., 1934, v. 17, pp. 29-36; Amer. Jour. Ophth., 1936, v. 19, pp. 238-240.

LOCAL USE OF SULFANILAMIDE COMPOUNDS IN THE EYE*

JACK S. GUYTON, M.D.
Baltimore, Maryland

Ophthalmologists have from time to time employed various sulfanilamide compounds locally in the treatment of ocular infections. The majority of these compounds (including sulfanilamide, sulfapyridine, and sulfathiazole) act directly upon infecting organisms *in vitro* as well as *in vivo*. Theoretically, local therapy with one of these drugs should be efficacious if the ocular infection is limited to the conjunctiva and cornea, provided an adequate concentration of the drug is maintained at the site of infection. The scanty literature on this subject is difficult to evaluate. We have therefore tested the local application of various preparations of these drugs to determine if there is a practical basis for local ocular therapy.

SUMMARY OF LITERATURE

Rambo[1] demonstrated that injection of sulfanilamide into the anterior chamber of rabbits is an effective prophylaxis against subsequent infection of the anterior segment of the eye by streptococci.

Jensen, Johnsrud, and Nelson[1a] treated a series of 39 patients who had compound fractures and 2 who had compound dislocations by debridement, with local implantation of from 5 to 15 grams of sulfanilamide crystals in the wound and primary closure. In this series there was not a single primary wound infection. In a previous series of 94 compound fractures treated similarly except that sulfanilamide was not used locally, the incidence of infection was 27 percent. Subsequent clinical and experimental reports have confirmed the fact that the prophylactic introduction of sulfanilamide crystals before closing compound fractures brings about a very significant decrease in resulting infections, without delaying the healing of bones or soft tissues.

Sulfanilamide has been used locally in the treatment of meningitis, empyema cavities, infected tooth sockets, gonococcal vaginitis in children, erysipelas, bronchitis, and chronic suppurating wounds of osteomyelitis.[2, 3] However, although some of the reports of the results obtained are enthusiastic, the actual value of the treatment has not been fully substantiated in any instance.

TABLE 1

RESULTS OBTAINED BY REIN AND TIBBETTS IN THE TREATMENT OF GONORRHEAL CONJUNCTIVITIS

Treatment	No. of Cases	Average Days of Treatment Before First Negative Smear	
Classical: irrigations with boric acid	15	27.2	
Irrigations with 0.5-percent sulfanilamide solution	10	9.3	
Irrigations with 0.5-percent sulfanilamide solution plus sulfanilamide by mouth	5	1.8	6.8

Only one complete report with regard to the local use of sulfanilamide itself in human ocular infections is available. Rein and Tibbets[4] treated 15 patients with gonococcal conjunctivitis by means of irrigations of 0.5 percent sulfanilamide solution every 15 minutes, day and night. The results of this therapy as contrasted with the results obtained in 15 preceding cases are given in table 1. It is difficult to accept the argument that irrigations with sulfanilamide solution constitute a procedure of great practical value in the treatment

* From the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital and University.

of gonococcal conjunctivitis, for the reason that it is well substantiated that the systemic administration of sulfanilamide, sulfathiazol, or sulfapyridine is much more effective and is usually all that is necessary in the way of therapy. However, Rein and Tibbetts have conclusively shown that local sulfanilamide therapy is superior to irrigations with boric acid.

Uliron (dimethyldisulfanilamide), which is known to be effective *in vitro*, has been used by Kattiofsky[5] in the form of a 5-percent ointment in the treatment of four cases of gonorrheal conjunctivitis. The ointment was instilled into the conjunctival sacs every two hours, the patients having previously received local irrigations every half hour for two weeks. In each instance a further period of from three to five weeks elapsed before the gonococci disappeared from the conjunctival sacs.

Burnet and his co-workers[6] have employed a glucose derivative of "4:4'-diaminodiphenylsulfone" in 7-percent solution subconjunctivally in the treatment of 18 cases of trachoma. They report markedly beneficial effects on the corneal lesions, but only slight improvement of the conjunctival lesions. The results of local treatment of trachoma with other less-soluble sulfanilamide compounds did not impress these authors as encouraging.

Neoprontosil has been used locally by a number of ophthalmologists, probably because it is more soluble than sulfanilamide. However, neoprontosil, which consists of sulfanilamide joined to an azo radical, is inactive *in vitro*, and gains its activity only when the sulfanilamide radical is released within the body. Neoprontosil is of no theoretical value when merely instilled into the the conjunctival sac, but when it is injected subconjunctivally a small amount of sulfanilamide is liberated (see below). Paton[7] has reported some good results with the subconjunctival injection of this drug in trachoma, Roggenkamper[8] in corneal ulcers, and Heinz[9] in a single case of endophthalmitis.

Experimental

The fundamental requirement for successful local therapy with sulfanilamide is obviously the maintenance of an adequate concentration of the drug at the site of infection. The amount of diffusion of sulfanilamide into the anterior chamber of rabbits has been investigated in order to determine the relative efficiency of each of a number of sulfanilamide preparations.

Although sulfanilamide is soluble (in water or normal salt solution) up to about 47 percent at 100°C., it is soluble only to about 0.8 percent at 37°C. In table 2 are given the aqueous sulfanilamide concentrations obtained after instilling an 0.8-percent solution of the drug (in normal saline) into the conjunctival sacs of rabbits every 10 minutes for 4 hours. The optimum blood (and aqueous) concentration of sulfanilamide after oral administration ranges from about 5 to 15 mg. percent. It is therefore apparent that the aqueous levels obtained by local instillation represent a very appreciable concentration, and the actual concentration of the drug within the corneal tissue is probably much higher than the aqueous level. However, local instillations of sulfanila-

TABLE 2

AQUEOUS SULFANILAMIDE CONCENTRATIONS AFTER INSTILLATION OF 0.8-PERCENT SULFANILAMIDE SOLUTION INTO THE CONJUNCTIVAL SACS OF RABBITS

Determination	Instillations	Aqueous Sulfanilamide Level (mg.%)
1	Every 10 min. for 4 hrs.	5.3
2	Every 10 min. for 4 hrs.	8.7
3	Every 10 min. for 4 hrs.	2.1
4	Every 10 min. for 4 hrs.	3.3

TABLE 3

AQUEOUS SULFANILAMIDE CONCENTRATIONS AFTER INSTILLATION OF NEOPRONTOSIL (2.5-PERCENT SOLUTION) INTO THE CONJUNCTIVAL SACS OF RABBITS

Determination	Instillations	Aqueous Sulfanilamide Level (mg.%)
5	Every 10 min. for 4 hrs.	0.0
6	Every 10 min. for 4 hrs.	0.0
7	Every 10 min. for 4 hrs.	0.0
8	Every 10 min. for 4 hrs.	0.0

mide solution are of limited practical use in treating patients because of the frequency with which the drops must be instilled to maintain an even concentration.

Neoprontosil (2.5-percent solution) instilled into the conjunctival sacs of rabbits yielded no measureable amount of sulfanilamide in the aqueous (table 3). After subconjunctival injections of 1 c.c. of this solution, small amounts of sulfanilamide did appear in the aqueous for as long as five hours after the injection (table 4). The subconjunctival concentration of sulfanilamide was probably much higher during this period. Since no measurable quantity of sulfanilamide could be detected in the blood following subconjunctival injections, it is apparent that the neoprontosil must have broken down with liberation of sulfanilamide within the subconjunctival tissues and that the sulfanilamide must have diffused into the aqueous through the anterior sclera rather than by way of the blood stream.

TABLE 4

AQUEOUS SULFANILAMIDE CONCENTRATIONS AFTER SUBCONJUNCTIVAL INJECTION OF 1 C.C. OF NEOPRONTOSIL (2.5-PERCENT SOLUTION) IN RABBITS

Determination	Interval Following Injection Before Aqueous Was Withdrawn	Aqueous Sulfanilamide Level (mg.%)	Simultaneous Blood Sulfanilamide Level (mg.%)
9	1 hr. 15 min.	1.0	0.0
10	3 hrs.	1.0	0.0
11	3 hrs.	1.0	0.0
12	5 hrs.	0.5	0.0
13	7 hrs.	0.0	0.0
14	7 hrs.	0.0	0.0

TABLE 5

AQUEOUS SULFANILAMIDE CONCENTRATIONS AFTER INSTILLATION OF VARIOUS 5-PERCENT SULFANILAMIDE OINTMENTS INTO THE CONJUNCTIVAL SACS OF RABBITS

Determination	Instillations	Aqueous Sulfanilamide Level (mg.%)
I. OINTMENT #2 (PETROLATUM-CASTOR OIL BASE. SLIGHTLY IRRITATING BECAUSE OF CRYSTALS)		
15	Control (washed out immediately)	0.0
16	Control (washed out immediately)	0.4
17	Every hour for 3 hrs.	2.3
18	Every half hr. for 1 hr.	13.5
19	Every half hr. for 1 hr.	18.0
20	Every half hr. for 4 hrs.	26.2
21	Every half hr. for 4 hrs.	19.8
22	Every half hr. for 4 hrs.	29.4
23	Every half hr. for 4 hrs.	18.8
II. OINTMENT #3 (TRAGACANTH-GLYCERINE BASE. MODERATELY IRRITATING)		
24	Control	0.0
25	Control	0.3
26	One(aqueous withdrawn 1 hr. later)	1.8
27	Every hr. for 3 hrs.	1.4
28	Every half hr. for 1 hr.	1.9
29	Every half hr. for 1 hr.	5.3
30	Every half hr. for 4 hrs.	5.7
31	Every half hr. for 4 hrs.	2.5
III. OINTMENT #4 (COLLOIDAL SUSPENSION IN 4-PERCENT SODIUM ALGINATE. OINTMENT NOT STABLE)		
32	Every half hr. for 4 hrs.	34.8
33	Every half hr. for 4 hrs.	45.0
IV. OINTMENT #8 (COLLOIDAL SUSPENSION IN SODIUM ALGINATE-AQUAPHOR-PETROLATUM-CASTOR OIL BASE. A STABLE OINTMENT, LESS IRRITATING THAN ANY OF ABOVE)		
38	Every half hr. for 4 hrs.	26.9
39	Every half hr. for 4 hrs.	30.0
40	Every half hr. for 4 hrs.	34.6
41	Every half hr. for 4 hrs.	39.9
42	Every half hr. for 4 hrs.	34.2
43	Every half hr. for 4 hrs.	36.7

Sulfanilamide ointments proved more satisfactory than did fluid preparations in attaining high aqueous sulfanilamide lev-

els. A number of different ointment bases containing sulfanilamide in an arbitrary concentration of 5 percent were prepared by Mr. T. C. Kleczynski of the Johns Hopkins Hospital Pharmacy. The aqueous sulfanilamide levels in rabbits receiving these ointments locally in the conjunctival sacs are shown in table 5. Significantly different results were obtained with different ointment preparations, the best result being obtained with ointment "#8."

To eliminate the possibility that the aqueous sulfanilamide levels might have been increased by some sulfanilamide ointment being picked up in the needle used to withdraw the aqueous, the eyes of the experimental animals were irrigated thoroughly with saline before the anterior chambers were punctured. The "control" observations recorded in table 5 indicate sulfanilamide levels obtained after instilling the ointment into the conjunctival sac and immediately washing it out according to the standard procedure used in all the other determinations. The insignificant values obtained in these controls prove that the irrigations were efficacious in removing the ointment from the corneal surface.

Sulfanilamide ointment "#8" is prepared as follows: Ten parts of sulfanilamide are dissolved in 25 parts of boiling water, and 4 parts of sodium alginate in 75 parts of boiling water. These are mixed and stirred until cool, the sulfanilamide and sodium alginate precipitating out in a smooth, colloidal form. Sixteen parts of "aquaphor" (absorption base), 1 part of sodium chloride dissolved in 4 parts of water, and 78 parts of white vaseline are added and the mixture stirred until a smooth, creamy ointment results.

Sulfapyridine is approximately one tenth as soluble as sulfanilamide, and sulfathiazole is approximately as soluble as sulfapyridine. Sodium sulfapyridine is very soluble, but it has a high pH which makes it somewhat irritating, and it apparently must be precipitated as sulfapyridine before it can penetrate the cornea. Observations on the diffusion of sulfapyridine and sodium sulfapyridine, instilled in ointment form into the conjunctival sacs of rabbits, are recorded in table 6. The aqueous sulfapyridine values obtained were quite low, as would be expected because of the low solubility.

Clinical observations

Eighteen patients with bilateral catarrhal conjunctivitis treated with 5-percent sulfanilamide ointment in one eye and a control ointment (that is, a similar ointment base without the sulfanilamide) in the other eye are here reported. The ointments were instilled into the conjunctival sacs of the two eyes every hour while the patient was awake. Results of this treatment are as follows:

1. *Ten patients with bilateral staphylococcal conjunctivitis.* In four the cultures became negative in both eyes simultaneously, in four the cultures remained positive in both eyes throughout the period of observation, and in only two instances did the cultures become negative in the eye receiving the sulfanilamide ointment before they became negative in the control eye.

TABLE 6

AQUEOUS SULFAPYRIDINE CONCENTRATIONS AFTER INSTILLATION OF VARIOUS 5-PERCENT SULFAPYRIDINE OINTMENTS INTO THE CONJUNCTIVAL SACS OF RABBITS

Determination	Instillations	Aqueous Sulfapyridine Level (mg.%)
I. OINTMENT #10 (PETROLATUM-CASTOR OIL BASE. SLIGHTLY IRRITABLE BECAUSE OF THE CRYSTALS)		
44	Every half hr. for 4 hrs.	1.3
45	Every half hr. for 4 hrs.	0.6
46	Every half hr. for 4 hrs.	0.8
47	Every half hr. for 4 hrs.	1.3
II. OINTMENT #11 (SODIUM SULFAPYRIDINE IN PETROLATUM-AQUAPHOR BASE. IRRITABLE AFTER REPEATED INSTILLATIONS BECAUSE OF HIGH pH)		
48	Every half hr. for 4 hrs.	1.4
49	Every half hr. for 4 hrs.	2.4
III. OINTMENT #12 (SODIUM SULFAPYRIDINE IN 4-PERCENT SODIUM ALGINATE BASE. OINTMENT UNSTABLE)		
50	Every half hr. for 4 hrs.	1.6
51	Every half hr. for 4 hrs.	1.3

2. *Six patients with bilateral Koch-Weeks conjunctivitis.* In all instances the cultures either became sterile at the same time in both eyes or remained positive throughout the period of observation in both eyes.

3. *One patient with alpha streptococcus conjunctivitis and one with pneumococcus conjunctivitis.* The cultures became sterile in both eyes at the same time.

It is obvious that no practical result can be ascribed to the use of sulfanilamide ointment locally for catarrhal conjunctivitis due to the above-named infecting organisms. However, the possible value of the sulfanilamide was undoubtedly lessened by the fact that these patients were ambulatory and therefore did not use the ointment during the night. Further, the bland control ointment base itself, instilled into the conjunctival sac every hour, appeared to constitute remarkably efficient treatment for the conjunctivitis.

Five-percent sulfanilamide ointment was used in five patients with trachoma, for periods ranging from 2 to 42 days. Three patients were not benefited. There was definite improvement, but not an absolute cure, in the other two patients, both of whom used ointment "#8" for periods of 42 days each. The omission of treatment at night must have adversely affected the local value of the drug, but there is little evidence from these observations that sulfanilamide ointment is of any practical value in trachoma.

In one patient with gonococcal conjunctivitis no beneficial effect was observed after hourly instillations of sulfanilamide ointment for a period of 24 hours, beyond which time we did not feel justified in withholding systemic chemotherapy, the usual procedure in other cases of gonococcal conjunctivitis.

The results of treatment of infected corneal ulcers with sulfanilamide ointment have been encouraging. Obviously no controls could be run in the case of ulcers, and it is possible the same good results might have followed frequent instillations of an ointment base alone. Nevertheless, the fact is that in every case of infected corneal ulcer in which sulfanilamide ointment was used there was complete healing, and the majority of ulcers healed quite promptly. The patients were treated with 5-percent sulfanilamide ointment every hour day and night. The following results were obtained: (1) Seven staphylococcal ulcers, all of which were more or less severe and three of which were hypopyon ulcers, were completely healed in from 1 to 12 days, without exception. (2) One Koch-Weeks ulcer with hypopyon healed completely in 12 days. (3) Two severe ulcers of undetermined etiology healed in 1 and 3 days, respectively.

Two staphylococcal ulcers, one of them with hypopyon, were treated with 5-percent sulfapyridine ointment and healed in 6 and 11 days, respectively.

Comment

Theoretically, local chemotherapy in localized infections is a logical procedure. The experimental observations of Rambo and the clinical observations of Rein and Tibbetts have demonstrated that under certain conditions this type of therapy is of some definite value in ocular infections. The crux of the question therefore is whether or not such therapy is of practical value.

The use of sulfanilamide in ointment form is the best way to maintain an even, high concentration of the drug within the conjunctival sac (or at least against the cornea) without too frequent instillations. Ointment "#8" has proved the most effective of any preparation we have tried in attaining a high aqueous concentration. The chief reasons for this are, first, that the sulfanilamide in this ointment is in

colloidal form and, second, that it is only very slightly irritating and therefore not washed away by excessive lacrimation.

It is logical that the local application of sulfanilamide ointment should produce a more beneficial effect on corneal infections than on conjunctival infections, because it is difficult to get the ointment up into the crevices of the upper fornix. The necessary absence of control observations prevents the definite conclusion that sulfanilamide ointment was the direct factor in the healing of the corneal ulcers here reported. However, treatment with this ointment was entirely harmless, and either the cleansing effect of the ointment base or the sulfanilamide itself did have a beneficial effect.

In spite of the relatively greater solubility of sulfanilamide, other agents such as sulfapyridine or sulfathiazole may ultimately prove to be better when used locally for certain types of infection. However, the ideal sulfanilamide derivative for optimal local effects is one which is freely soluble and at the same time possesses a high relative degree of bacteriostasis. At present no such compound has been studied, and the practical value of sulfanilamide compounds for local use is therefore quite limited. The most encouraging sphere of usefulness is in the treatment of infected corneal ulcers.

Summary

1. Sulfanilamide compounds which are effective *in vitro* are of theoretical value when used locally for infections of the conjunctiva and cornea.

2. Sulfanilamide in ointment form is at present the most suitable preparation for local use.

3. In 18 cases of catarrhal conjunctivitis due to the ordinary infecting organisms, 5-percent sulfanilamide ointment did not appear more efficacious than did an ointment base without the sulfanilamide.

4. Two out of five cases of trachoma were improved but not cured by prolonged use of 5-percent sulfanilamide ointment.

5. Encouraging results have been obtained with the use of 5-percent sulfanilamide ointment in the treatment of infected corneal ulcers.

References

[1] Rambo, V. C. Effects of sulfanilamide on rabbit's eyes. Amer. Jour. Ophth., 1938, v. 21, pp. 739-746.

[2] Jensen, N. K., Johnsrud, L. W., and Nelson, M.C. The local implantation of sulfanilamide in compound fractures. Surgery, 1939, v. 6, pp. 1-12.

[3] Bosse, G. Ueber die Möglichkeit der örtlichen Prontosilanwendung in der inneren Klinik. Deutsche med. Woch., 1938, v. 64, pp. 116-118.

[4] Bigler, J. A., and Haralambie, J. Q. Sulfanilamide and related compounds. A review of the literature. Amer. Jour. Dis. Child., 1939, v. 57, pp. 1110-1167.

[5] Rein, W. J., and Tibbetts, O. B. Irrigations with sulfanilamide as treatment for gonorrheal conjunctivitis. Amer. Jour. Ophth., 1939, v. 22, pp. 1126-1129.

[6] Kattiofsky, W. Erfahrungen über die Wirksamkeit der Sulfanilamide bei gonorrhöischen Augenerkrankungen. Klin. M. f. Augenh., 1939, v. 103, Aug., pp. 214-220.

[7] Burnet, E., Cuénod, E., and Nataf, R. Essai de chimiothérapie du trachome par un dérive glucose due "4:4′ diaminodiphenylsulfone." Efficacité sur le pannus trachomateus. Arch. de l'Institute Pasteur de Tunis, 1939, v. 28, pp. 11-28.

[8] Paton, R. T. Subconjunctival injections of neoprontosil in the treatment of ocular infections. Arch. of Ophth., 1939, v. 22, Sept., pp. 375-384.

[9] Roggenkamper. Hornhautulkus und Prontosil. Klin. M. f. Augenh., 1939, v. 103, pp. 211-214.

[10] Heinz, K. Subkonjunktivale Prontosilinjektionen bei Infektionen des Augafels. Klin. M. f. Augenh., 1938, v. 101, July, pp. 154-155.

MODIFICATION OF THE HOTZ OPERATION FOR ENTROPION DUE TO TRACHOMA*

J. S. MAXWELL, M.D.
Fairmont, West Virginia

This technique has been evolved over a space of 17 years, during which period a total of 537 different lids have been operated on. The modifications included in this operation were largely the result of trial and error over that period of time. Because there was so much error, there were numerous modifications. I heard a prominent surgeon once say that he had never seen a totally successful operation for entropion.

To emphasize this point, which is the only justification for offering a new technique, the following example will suffice:

I was permitted to attend an operation for entropion done by the inspector for all the ophthalmic hospitals in Egypt. This man represented the acme of perfection in technical skill and unusually wide experience. As he deftly operated, he casually remarked, "This is the five thousandth case of entropion on which I have operated."

He passed the knife across the tarsus and back again, in two single strokes, and at the end of the second stroke with a twist of the fingers he flipped out the wedge of tarsus. Undoubtedly he cut entirely through the lid. He was finished and had all his sutures inserted in three minutes. It was easily the most skillful surgical demonstration that I had ever seen and I decided to go back on the third day when the first dressing was done. The operator perhaps had forgotten that I had seen the original operation and remarked after he had removed the dressings: "I will have to do this over again."

Thus it is common experience that there are far too many recurrences after operations for entropion. I have not had to do a third operation on any patient of this series. Since the present technique has been used, only 11 second operations were needed on the last 100 cases.

Preparation. It is important to carry out thorough daily treatment of the palpebral conjunctival fornices and especially of the caruncle, with 1- to 2-percent silver nitrate, freshly made daily. The active trachomatous process should be well under control before the lids are operated on. Allergies should be studied.

Anesthesia. A 1-percent solution of novocaine is injected under the skin by inserting a long thin needle through a pinched-up fold of skin, 6 mm. above the external canthus. If this pinching is done firmly, there is no pain. The 6 c.c. of this fluid balloons out the lid well. A lesser amount is used if work is done on the lower lid. After ten minutes the anesthesia is complete. At first this was all the anesthetic that was used. But only as late as 1938 did I learn of another technique; namely, injection along the superior border of the tarsus. By this brilliant discovery total anesthesia is promptly obtained. Two drops of a 2-percent solution of butyn, instilled in the cul-de-sac every five minutes for five times, one-half hour before operation, will somewhat relieve the discomfort of the lid elevator.

Operation. The skin of the lids, cheek, nose, eyebrows, and forehead is scrubbed with tincture of metaphen soap and flushed off thoroughly with boric solution; the skin is then thoroughly dried and painted with tincture of merthiolate

* Read before the Pittsburgh Ophthalmological Society on February 26, 1940.

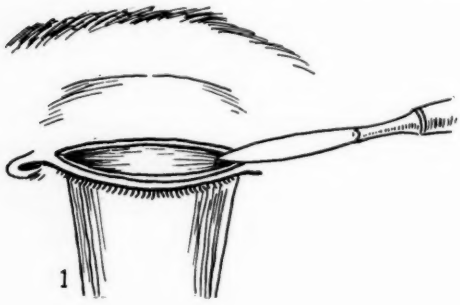
(however, the patients seemed to do just as well without the latter). A metal lid elevator with generous-sized handle is used. A ball of cotton the size of a small lemon, covered with a single layer of gauze to prevent it from spreading, is placed in the hollow of the cheek between the nose and the promontory of the maxillary bone; it gives a good fulcrum for the lid elevator and a good firm elevation. A skillful assistant can bring the tarsus well into the field of operation. With an upward thrust of the elevator, while at the same time depressing the handle, one obtains a completely bloodless field, unless the small branches of the palpebral branch of the angular artery are cut. It is my impression that a better result is obtained if they are cut. If troublesome, a mosquito hemostat controls the hemorrhage. If the lid elevator slips out it is because the assistant fails to push up at the same time that he elevates the lid.

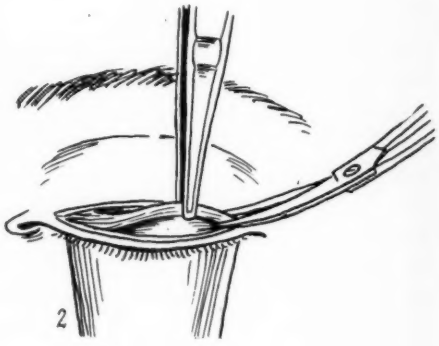
The incision is made in the skin concentric to the lid border, extending from canthus to canthus, and deeply, well into the tarsus. It is placed about 3 mm. distal to the lid border and at the extremities should extend 2 mm. beyond the last external and internal cilia. A second incision is made above this, starting from the canthus and swinging upward from 3 to 8 mm. at the widest part of the ellipse and back to the other canthus. The amount depends on the bagginess of the skin of the lids. This ellipse is then cut off with scissors (fig. 1). It was probably first suggested by Jäsche, in 1844, in his first operation. The incision is made boldly, deeply, but should not go deeper than to the palpebral conjunctiva. Many operators cut right through this, but I fail to see that anything is gained by this mutilating operation. Admittedly, it is difficult to gauge the depth of the incision closely. Hence, to be safe, it is better to etch through the tarsus cautiously after the first bold incision. As soon as the incision is made, curved scissors are used to excise the orbicularis muscle (fig. 2). This is usually found to be hypertrophied, which probably accounts for the spasm of this muscle, so often seen in these patients. Anagnostakis, in 1857, first resected the lower fibers of the orbicularis; but the good and lasting results on patients who have been observed for as long as 15 years after operation, and who had had all the orbicularis over the tarsus resected, would seem to indicate that this is the preferred procedure.

The upper margin of the skin incision can now be pushed upward and caught underneath the lid elevator. This clears the field and is a great help. Hemostasis is now secured mainly by means of firm elevation of the lid elevator. If there is any pathologic tissue left in the angles, this is thoroughly cleaned out. The most frequent cause of the necessity for a second operation is the tissue left in the angles, especially in the external angle. A board Bard-Parker type of knife is used, and the tarsus is shaved off, starting at the upper margin and proceeding downward until the knife emerges through the original incision. As much tarsus as possible is removed with successive shavings, but enough is left (0.5 to 1.0 mm.) to preserve the contour of the lid (fig. 3). Tarsectomy too often ends in ectropion. Streatfield, in 1858, first taught the danger of the incurved tarsus. The rougher the shaved surface is, the better adhesions form to it and the better the result. Again, the extremities of the tarsus, both internal and external, must be included at least as far as the cilia extend.

Dermol 00 suture is threaded through a stout, three-quarter-inch, semicurved needle and three matress sutures are passed through, between the extremities

of the line of the lashes (fig. 4). Each suture is inserted through the lid margin and is mattressed through the upper part of the tarsus and brought out again





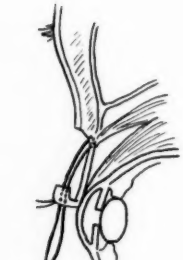


Fig. 1 (Maxwell). Skin incision forming an ellipse.
Fig. 2 (Maxwell). Excision of orbicularis muscle with curved scissors.
Fig. 3 (Maxwell). Removal of tarsus.
Fig. 4 (Maxwell). Placing of sutures.
Fig. 5 (Maxwell). Sutures passed through the lid margins.

through the lid margin, including in each suture as much tissue as possible. Thus a good firm bite through the tarsus is obtained and plenty of anchorage in order to get good eversion of the ciliary margin, so that when the sutures are tied the margin of the lashes is over-everted. This was Anagnostakis's main idea. Spencer Watson, 1874, seems to have first suggested passing the suture through the lid margin, although Panas, in 1882, probably popularized it, in that he insisted on a firm anchorage of the everted lid margin (fig. 5). Snellen, in 1870, used practically the same technique. The suture is tied with a triple knot. It is put in as one con-

tinuous suture to save time and confusion, and the ends cut long enough after insertion of the suture so that the six ends may be twisted together and be fastened by adhesive to the skin just above the eyebrow. This gives an even, gentle elevation of the lid margin.

In placing the dressing, care is used so that the cornea shall be covered with the closed lid. The first dressing is done on the fifth day. The sutures are not removed for seven days, because occasionally some adhesions form along the suture line if they are left in for several days. The dermol is easily removed without pain.

Canthotomy is not performed, chiefly because the lid tension can be largely relieved by the removal of the orbicularis and most of the tarsus.

Both upper lids may be operated on at the same sitting.

The lower lid is operated on in practically the same way except that the lower tarsus is never so thick and pathological as the upper, and there is, therefore, no need for so much tarsal excision. The end results are not so satisfactory in the lower lid as they are in the operation on the upper lid. I realize that I have never mastered the care of the lower lid. Fortunately, out of the total number of lids operated on, only 64 were lowers.

Comment. The extra thickness of the orbicularis muscle, the ptosis, the spasmodic sphincter action of this muscle, and the locus of the pathogenic virus all combine to injure the cornea. The palpebral conjunctiva seems most affected as it approaches the fornix. This is the area that covers the upper limbus of the cornea. Therefore we stress the following conception of the mechanism of trachomatous keratitis, fully aware that primary and specific trachomatous invasion of both cornea and bulbar conjunctiva is fairly well proved:

The virus in the follicles of the conjunctiva or the diffuse virus deep in the conjunctiva, when there are no follicles, is continually being rubbed into the corneal epithelium by the spasmodic action of the orbicularis.

The ptosis tends to approximate the virus-bearing tissue directly over the upper cornea. These pathological, hypertrophied tarsi varied from 2 to 6 mm. in the anterio-posterior diameter. Many were honey-combed, like Swiss cheese, with cystic spaces in which were hyalin and fatty degeneration. Occasionally the lacunae were filled with caseation necrosis and were felt through the advancing knife edge before they were seen. Such gross pathology immediately suggested that the tarsus was a prime seat of the trachomatous process.

Intermarginal grafts were not found to be necessary. The chronic, mild blepharophimosis is one of the main evils attacked in this operation.

The tucking of the levator tendon as advocated by Pagenstecher is avoided by the Jäsche-Arlt method of removing the ellipse of skin. This serves quite as well if the remaining skin of the lid adheres firmly to the tarsal remnant.

No suture is needed in the skin incision, but care should be taken that the margins lie smoothly in apposition before the dressing is applied. The sutures taped onto the skin above the eyelid prevent any ordinary displacement, and later the incision scar line is almost invisible.

As with most surgical dressings a fluffed gauze dressing is better than a solid flat one. The dressing should not stick, and a fluffed dressing has fewer contact points than a flat dressing plastered down tightly.

At the first dressing it is helpful to hold a sterile cotton applicator on the lid scar to oppose the force of removal of the adherent dressing. Skin incisions heal better

if left dry. Ointments do not aid in the healing of cut surfaces; keep them dry.

Only theoretically is there danger of getting too great eversion of the cilia-bearing margin of the lid. Practically it is impossible, and especially in the angles.

This operation is more "altogether" than Beard's of that name in that more tissue is removed. The firm, broad scar resulting from the removal of the ellipse of skin, orbicularis, and most of the tarsus leaves almost no chance for the cilia-bearing margin to invert, even years later.

To make the incision right up to the base of the cilia and remove the diseased tarsus bed near the bulbous roots of the cilia not only would seem logical, but experience proves that it succeeds. We have all seen entropion corrected, yet trichiasis appear as a late result. With this operation it is hard to imagine how trichiasis could possibly result and it actually does not happen.

Conclusion

1. The tarsus is thought to be the main and deepest-seated focus of continued reinfection in trachoma. How can local treatment penetrate to the depths of this hypertrophied tissue? Diathermy and X-ray have failed to cure. So removal of the tarsus seems logical.

a. Total tarsectomy is too mutilating. Therefore a thin shell is left. Scarring soon squeezes out the virus, but sufficient tarsus is left to preserve its very necessary physiological function.

2. Excision of an ellipse of skin with subsequent firm adhesion of the remainder to the bare tarsus cures the ptosis more simply and more lastingly than does tucking of the levator tendon.

3. It is thought that there is in trachoma IV a partial and recurrent blepharospasm that repeatedly rubs the virus, which is in the conjunctiva, upon the upper limbus and cornea, resulting in continual reinfection of the trachomatous cornea, keratitis, and its attempted repair in an avascular tissue by the formation of new vessels; that is, pannus. This is probably a mechanism of defense. Hence I freely excise the orbicularis. This eases up the tight lid. Just why it does not induce lagophthalmus is not clear. Perhaps in the same way that we get action in the iris sphincter after iridectomy.

4. The operation is painless and can be done in the office without danger, provided the usual surgical precautions are observed. In this stage there is practically no danger of transmittal of the infection to other patients.

5. In my hands, now over a period of 17 years, this technique has proved successful as to both early and late results.

6. Ophthalmologists experienced in trachoma believe that only an abundance of scarring will ever completely heal trachoma. The above-mentioned technique removes almost all the diseased tissue except the conjunctiva, which, having already been treated, has induced sufficient cicatrization. The scarring, atrophy, and degeneration thus produced usually protect the lacrimal-gland, sac, caruncle, fornices, and bulbar conjunctiva against defects. The tarsus, however, is already concave over the eye, and contraction from scarring makes it worse; hence it must be removed.

309 Cleveland Avenue.

EXTRAFOVEAL VISUAL ACUITY AS MEASURED WITH SNELLEN TEST-LETTERS*

ELEK LUDVIGH, PH.D.
Boston

The manner in which visual acuity decreases as the test object moves toward the periphery of the visual field is of importance from several points of view. Nevertheless, as Evans[1] says, "A review of the literature for studies embracing the problem of acuity fields is disappointing." Wertheim[2] and Weymouth, Hines, Acres, Raaf, and Wheeler[3] used a grating test object, Adler and Meyer[4] as also Hofmann[5] a contour-break test object, Hirschberg[6] employed German characters, Aubert and Förster[7] undescribed numerals and letters. Leber[8] made use of Snellen's hooks, Aubert[9] investigated the ability of the eye to resolve two dots on a black background, Bourdon[10] employed the alignment test. Dor[11] and Dobrowolsky and Gaine[12] employed Snellen letters. Procedure such as that of Rönne[13] in which white discs of various sizes are used is more commonly thought of as campimetry than as an investigation of visual acuity.

In none of these investigations did the experimental conditions closely approximate those existing during the usual clinical testing of visual acuity. In order to prevent eye movements during the course of an observation some investigators employed spark illumination or tachistoscopic presentation. Other experiments were conducted under conditions of dark adaptation. The two investigations which employed Snellen test-letters were conducted at unknown intensities of illumination, and before incandescent lamps were commonly available. The background against which the letters were presented was black and the letters were only 20 cm. and 1 foot from the eye. Furthermore, visual acuities of better than 20/120 were not observed in the peripheral field of vision.

In order to provide clinically applicable data concerning the regional variation in visual acuity it seemed advisable to determine such variation under conditions that closely approximate those prevailing during the conventional testing of visual acuity. Snellen letters should be used as test objects. These letters should be at a considerable distance, preferably about 20 feet, from the eye. The letters should be presented against a white background and the illumination provided should be adequate and continuous.

In order to fulfill these requirements the following simple set-up was employed. A vertical row of square apertures was cut out of a piece of rectangular white cardboard 45 by 70 cm. in size in such fashion that test-letters of a Snellen test chart could be exhibited one by one through each aperture. This cardboard was vertically mounted on a wooden framework. Sliding horizontally along the top of the framework was a wooden stick to which was attached a long vertical strip of cardboard. Black spots 4.5 mm. in diameter were pasted on this strip of cardboard, each black spot being so placed that its height was the same as that of a line on the Snellen chart. The entire vertical row of fixation points could thus be displaced horizontally so as to cause any particular aperture to be imaged at the desired position on the horizontal meridian of the retina. Illumination of the chart was provided by means of two

*From the Howe Laboratory of Ophthalmology, Harvard University, and the Massachusetts Eye and Ear Infirmary.

X-ray viewers equipped with 200-watt lamps. The light appeared slightly bluish white. As measured by a Macbeth illuminometer the intensity of illumination on the chart varied from line to line. This variation is attributable to the fact that the effective light sources, although quite diffuse, were placed relatively close to the chart. During the present investigation the intensity of illumination varied between 26.6 and 36.0 foot-candles, depending on the line in use. This is a variation of about 26 percent. A similar variation in intensity of illumination from line to line frequently exists during the usual clinical testing of visual acuity with Snellen charts. Thus at the Massachusetts Eye and Ear Infirmary the charts in the vision room are illuminated by two laterally situated double light sources. The intensity of illumination on the different lines varies between 12.0 and 18.4 foot candles. This is a variation of about 35 percent. Variations of this magnitude in the intensity of illumination have little influence on central visual acuity.[14]

Observations were taken at a distance of 6 meters, or about 20 feet, and 2 meters, or about 7 feet. They were made monocularly, the left eye being covered with a patch. A chin rest was provided and the median plane of the observer's head was approximately directed toward the test-letters. Thus those observers who wore spectacles rotated their eyes behind the lenses so that the astigmatism by oblique incidence due to the spectacle lens was effective for the fixation point and not for the test object. The test employed only 5 different letters of the test chart and the same 5 letters of appropriate size were used on each line. These letters were F, E, C, L, T. They were selected because they occurred most frequently on the Snellen chart employed. The visual acuity was determined by employing a modification of the method of right and wrong cases.

The procedure was as follows: A long strip of white cardboard rotatable about a horizontal axis was adjusted so that it obscured the line of square apertures from the observer's view. A letter was centered in the aperture on the line that was being used to test the acuity. The observer fixated the corresponding black fixation disc, which had been placed so as to provide the desired degree of eccentric fixation. The strip was now rotated so that the letter was in the field of view of the observer. The observer, knowing which 5 letters were employed, now stated which of these letters he believed to be the one presented. If the letter produced no clear perception in the observer, he was required to guess which one of the 5 letters it was. The visual acuity was arbitrarily designated in terms of the size of letters which would be required to produce 60-percent correct judgments. It is to be noted that since there were only 5 letters, 20-percent correct judgments would occur by chance. The size of the letters that would be necessary to produce 60-percent correct judgments was determined by simple linear interpolation. Application of the phi-gamma hypothesis[15] might result in somewhat more correct values, but it has been shown by Newhall[16] that linear interpolation may be utilized with slight error provided that the percentage values employed are not such that they would lie at the extreme tails of the corresponding phi-gamma function. The method of interpolation may be made clear by the following example. Suppose that with fixation of 2 degrees of eccentricity, 40 percent of the letters in the 20/20 line are read, and 70 percent of the letters on the 20/30 line are read. Since 60-percent correctness has been arbitrarily adopted as the standard of acuity it is apparent that the vision tested corresponds more closely to 20/30 than to 20/20. Indeed, since the 60-percent point

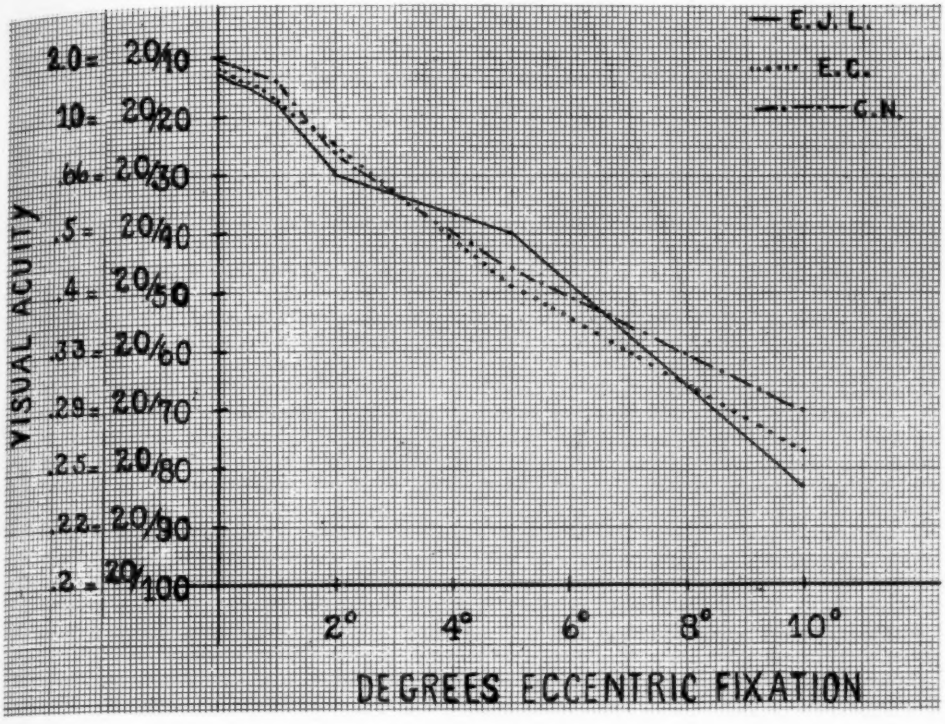


Fig. 1 (Ludvigh). Graph showing the visual acuity in Snellen terms exhibited by retinal regions eccentric from the fovea.

is twice as close to the percentage obtained on the 20/30 line as it is to the percentage obtained on the 20/20 line, linear interpolation indicates that if a 20/26.67 line were provided it would result in 60-percent correct judgments. The visual acuity would therefore be recorded as 20/26.67. The visual acuity at each degree of eccentric fixation was determined by means of 210 observations by each observer. Observations on any one day were taken with foveal fixation and with fixation 15 minutes, 30 minutes, 1 degree, 2 degrees, 5 degrees, and 10 degrees temporally eccentric from the center of the letter.

The results are given in table 1 and plotted in figure 1.

It may be observed from the figure that the individual differences between observers are everywhere less than one line on the usual Snellen test chart. The values of visual acuity are given on the y-axis both in Snellen notation and in another commonly used form of notation in which 20/20 vision equals 1. The values of acuity considerably exceed 20/20, but it is to be remembered that this is due in part to the adoption of an arbitrary criterion of

TABLE 1

VALUES OF VISUAL ACUITY RESULTING FROM ECCENTRIC FIXATION

Eccentric Fixation degrees	E. J. L.	E. C.	C. N.	Average
0.0	20/12.31	20/12.24	20/10.51	20/11.68
0.25	20/13.04	20/13.38	20/11.33	20/12.58
0.50	20/13.84	20/14.13	20/11.67	20/13.21
1	20/18.69	20/17.60	20/14.14	20/16.81
2	20/30.33	20/25.32	20/26.43	20/27.36
5	20/39.71	20/49.35	20/46.20	20/45.08
10	20/83.00	20/76.99	20/70.41	20/76.80

60-percent correct judgments. The Snellen visual acuity and the refractive error of the right eyes of the three observers, as tested in the usual fashion is as follows:

	Visual acuity	*Correction*
E. J. L.	20/15	—2.00 D.Sph. ⌯ —1 D.cyl. ax. 68°
E. C.	20/15	—3.62 D.Sph.
C. N.	20/15	+0.75 D.Sph. ⌯ +.37 D.cyl. ax. 90°*

* Not worn during experiments.

Figure 2 shows the average results for the three observers, the foveal acuity of each observer being taken as 1, and the visual acuity with various degrees of eccentric fixation being expressed as a fraction in terms of the foveal acuity. The resulting curve is shown in the solid line. The dashed line shows how the square root of the number of cones per sq. mm. varies from the center to the periphery of the human retina as determined by Østerberg.[17] The dotted line shows how the number of cones per sq. mm. varies under similar conditions. The value at the fovea is arbitrarily taken as unity in both instances. It appears likely that when the retinal image is located on some peripheral region of the retina there is some relationship between the visual acuity exercised by the eye and the density of cones at the same region of the retina. It might be thought that if visual acuity is dependent upon a discrimination of linear extents the square root of the number of cones would be a deciding factor, while if visual acuity is mainly dependent upon

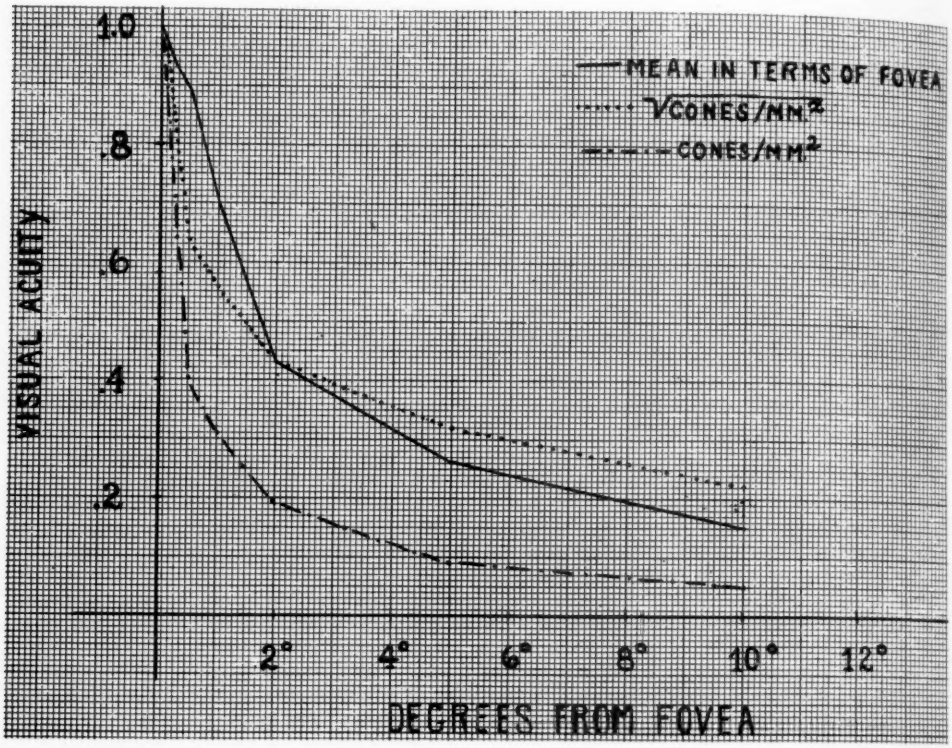


Fig. 2 (Ludvigh). Graph showing the visual acuity relative to the fovea exhibited by retinal regions eccentric from the fovea.

discriminations of areal extent, then the number of cones per sq. mm. would be a determining factor in the variation of visual acuity from center to periphery. It will be noted that the variation in visual acuity from center to periphery does not exactly parallel the decrease in either linear or areal density of cones from center to the periphery. This, however, is not surprising because near the fovea the fixation tremor of the eye[18] and the finite size of the test objects may cause the acuity to remain relatively high over a range of the central region of the retina, even though the density of cones decreases and shows no corresponding quasi plateau. In the periphery, on the other hand, the visual acuity of the eye is no doubt considerably affected by factors other than the density of retinal elements. Among the physical factors are somewhat reduced intensity of illumination, due to the oblique position of the pupillary plane relative to the line of vision, and changes in the refractive condition of the eye for the peripheral field of vision,[19a, b, c] due to astigmatism by oblique incidence and imperfect correction of curvature of field.

There are also certain "physiological" factors that may tend to reduce the exactness of perception of a retinal image falling on the periphery of the retina relative to that of a foveal image. Some of these "physiological" factors are probably greatly dependent upon anatomical variations in structure from the center to the periphery of the retina, such as the possible magnification due to oblique incidence of light on the clivus,[20a, b, c] the regional variation in convergence ratio[21] (ratio of bacillary-layer elements to optic-nerve fibers), the change in the density of yellow pigment[22a,b] from fovea to periphery, and the regional variation in the size of the retinal cones.[23a, b] Our knowledge of these physiological characteristics of the retina is much less extensive than is our knowledge of the physical optical properties of the refractive media of the eye. Still more obscure is the part played by the more centrally located neural structures in the process of reading Snellen letters. Despite this obscurity, however, it has been suggested by some investigators[24a, b, c, d] that central nervous system processes are the dominant features of sensory thresholds.

Despite present ignorance regarding the nature of the physiological mechanism responsible for visual acuity, there are certain facts which emerge from a consideration of the raw data of this investigation. Thus it appears, as is to be expected, that the letters vary in legibility.

TABLE 2

ORDER OF LEGIBILITY OF SNELLEN LETTERS

	C. N.	E. C.	E. J. L.	Committee Report[25]
1.	L	L	L	L
2.	F	F	C	T
3.	E	E	F	C
4.	C	C	E	F
5.	T	T	T	E

Table 2 shows the order of legibility of the five letters employed. The first three columns show the order of legibility for the three observers employed in this investigation, while the fourth column gives the results obtained by Jackson, Black, Ewing, Lancaster, and Fagin.[25] All results agree in indicating that L is the most easily read of the five letters, but the results of this investigation disagree with those of the committee in that all three observers in the present investigation find T the least legible letter instead of the second most easily read. This discrepancy may be attributable to the fact that the committee employed additional letters with which C, F, and E may have been easily confused. The order of legibility of the letters shows a slight change if the results for 10-degree eccentric fixation are

compared with those for the more central fixation in that at this peripheral location C is more easily read than L. Any explanation here of this phenomenon would be highly conjectural.

Another fact demonstrated by this investigation is that small central scotomas, even if complete, could not cause the reduction in visual acuity ordinarily attributed to them. It appears to be commonly believed that, in many cases of reduced acuity without ophthalmoscopic findings, the reduced acuity is explicable by reason of a complete macular defect. Thus in a typical case the acuity of one eye may be 20/20, that of the other 20/100 or 20/200. No cause for the reduced acuity is observed with the ophthalmoscope, but campimetric examination apparently reveals a small central scotoma of say one-half degree to one degree in radius. This central scotoma is accepted as the cause of the low acuity, but figure 2 shows that a scotoma of 1-degree radius will not of itself account for a reduction of visual acuity to 20/40, much less 20/100. Furthermore, as will appear in a later communication, it can be shown in many such cases that when the usual method of campimetric examination is employed, the apparent scotoma is really attributable to the reduced acuity rather than that the reduced acuity is caused by the scotoma. The situation appears to be that when the patient gives a negative response to the query as to whether he sees the test object this response is due not to his inability to see the object but rather to his inability to distinguish the test object from the fixation disc. This accounts for the apparent small size of many of these scotomas, since when the test object is sufficiently removed from the fixation disc the two can be resolved. If the scotoma is revealed by stereocampimetry the above argument is not so cogent, and the scotoma may be real rather than apparent. Even if a real scotoma exists, however, the data of this investigation show that the scotoma must be quite large in order to account for any considerable loss of acuity. In order to reduce the visual acuity to one fifth of its foveal value, it appears that the stimulus must be situated more than 7 degrees from the fixation point. If we arbitrarily assume that 20/20 is average foveal vision, then if vision of 20/100 is to be attributed solely to a central scotoma, this scotoma must be not 1 or 2 degrees but 14 degrees in diameter, since, if a region of the retina within 7 degrees of the fovea is unaffected, vision of better than 20/100 could be obtained. A central scotoma over 25 degrees in diameter would be required to account for vision of 20/200 in the absence of other defects. Central scotomas of this size are, of course, not common. To be sure, there are cases of a small hole in the macula with central fixation in which the patient cannot read the letters to which his attention is directed, but in such cases it may frequently be observed that the patient may spontaneously read letters on the next lower line, or may read letters on either side of the letter toward which the fovea is directed. It therefore appears that in cases in which the visual acuity is markedly reduced and only a small central scotoma is found, the scotoma, whether real or merely apparent, is not responsible for the reduced acuity, as has been assumed. Particular instances of this class of cases are individuals with so-called amblyopia ex anopsia without abnormal ophthalmoscopic finding and without seriously uncorrected refractive error. As will be demonstrated in a subsequent communication, many such individuals may be found, in whom, despite markedly deficient visual acuity, the foveal light-difference sense is normal. This tends to demonstrate that the "light sense" and the "form sense" are not necessarily, in the

absence of physical optical defects of the eye, inextricably associated and that in many cases some unknown defect, possibly quite unassociated with the "light sense," is the cause of the reduced acuity.

234 Charles Street.

References

[1] Evans, J. N. A scotoma associated with strabismus. Amer. Jour. Ophth., 1929, v. 12, p. 194.

[2] Wertheim, T. Ueber die indirekte Sehschärfe. Zeit. f. Psychol. u. Physiol. d. Sinnesorg., 1894, v. 7, p. 172.

[3] Weymouth, F. W., Hines, D. C., Acres, L. H., Raaf, J. E., and Wheeler, M. C. Visual acuity within the area centralis and its relation to eye movements and fixation. Amer. Jour. Ophth., 1928, v. 11, p. 947.

[4] Adler, F. H., and Meyer, G. P. The mechanism of the fovea. Trans. Amer. Ophth. Soc., 1935, v. 33, p. 266.

[5] Hofmann, F. B. Physiologische Optik (Raumsinn). Graefe-Saemisch Handbuch der gesamten Augenheilkunde. Ed. 2, Berlin, 1920, v. 3, ch. 13.

[6] Hirschberg, J. Ueber graphische Darstellung der Netzhautfunction. Arch. f. Anat. u. Physiol., 1878, v. 2, p. 324.

[7] Aubert, H., and Förster, R. Beiträge zur Kenntniss des indirekten Sehens. I. Untersuchungen über den Raumsinn der Retina. Arch. f. Ophth., 1857, v. 3, part 2, p. 1.

[8] Leber, T. Ueber das Vorkommen von Anomalien des Farbensinnes bei Krankheiten des Auges, nebst Bemerkungen über einige Formen von Amblyopie. Arch. f. Ophth., 1869, v. 15, pt. 3, p. 26.

[9] Aubert, H. Physiologie der Netzhaut. Breslau, 1864, p. 235 ff.

[10] Bourdon, B. La perception visuelle de l'espace. Paris, 1902, p. 146.

[11] Dor, H. Beiträge zur Electrotherapie der Augenkrankheiten. Arch. f. Ophth., 1873, v. 19, pt. 3, p. 316.

[12] Dobrowolsky, W., and Gaine, A. Ueber die Sehschärfe (Formsinn) an der Peripherie der Netzhaut. Arch. f. d. ges. Physiol., 1876, v. 12, p. 411.

[13] Rönne, H. Zur Theorie und Technik der Bjerrumschen Gesichtsfelduntersuchungen. Arch. f. Augenh., 1915, v. 78, p. 284.

[14] Ludvigh, E. The gradient of retinal illumination and its practical significance. Amer. Jour. Ophth., 1937, v. 20, p. 260.

[15] Boring, E. G. A chart of the psychometric function. Amer. Jour. Psychol., 1917, v. 28, p. 465.

[16] Newhall, S. M. Linear interpolation vs. the constant process. Amer. Jour. Psychol., 1927, v. 38, p. 390.

[17] Østerberg, G. Topography of the layer of rods and cones in the human retina. Acta Ophth., 1935, v. 13, suppl. 6.

[18] Adler, F. H., and Fliegelman, M. Influence of fixation on the visual acuity. Arch. of Ophth., 1934, v. 12, p. 475.

[19a] Ferree, C. E., Rand, G., and Hardy, C. Refraction for the peripheral field of vision. Arch. of Ophth., 1931, v. 5, p. 717.

[19b] Ferree, C. E., and Rand, G. The refractive conditions for the peripheral field of vision. Report of a joint discussion on vision. Cambridge, 1932, p. 244.

[19c] ———. Interpretation of refractive conditions in the peripheral field of vision. Arch. of Ophth., 1933, v. 9, p. 925.

[20a] Walls, G. Significance of the foveal depression. Arch. of Ophth., 1937, v. 18, p. 912.

[20b] ———. Postscript on image expansion by the foveal clivus. Arch. of Ophth., 1940, v. 23, p. 831.

[20c] Detwiler, S. R. Comparative anatomical studies of the eye with especial reference to the photoreceptors. Jour. Opt. Soc. Amer., 1940, v. 30, p. 42.

[21] Polyak, S. Minute structure of the retina in monkeys and in apes. Arch. of Ophth., 1936, v. 15, p. 477 (esp. p. 511).

[22] Duke-Elder, W. S. Textbook of ophthalmology. London, 1932, v. 1, p. 95.

[23] Kolmer, W. Die Netzhaut (Retina). Handbuch der mikroskopischen Anatomie des Menschen. Edited by W. von Möllendorff, Berlin, 1936, v. 3, pt. 2, p. 376.

[24] Koster, W. Étude sur les cônes et les bâtonnets dans la region de la fovea centralis de la rétine chez l'homme. Arch. d'Opht., 1895, v. 15, p. 428 (esp. p. 434-435).

[25] Greeff, V. Die mikroskopische Anatomie des Sehnerven und der Netzhaut. Graefe-Saemisch Handbuch der gesamten Augenheilkunde, Leipzig, 1900, v. 1, pp. 113-114.

[24a] Elsberg, C. A. The sense of vision. Introduction. Bull. Neurol. Inst., New York, 1937, v. 6, p. 233.
[24b] Elsberg, C. A., and Spotnitz, H. Are vision and the olfactory sense governed by the same laws? A comparison of the results of quantitative functional tests of vision and of the sense of smell and its significance. Ibid., p. 421.
[24c] Crozier, W. J., and Holway, A. H. Theory and measurement of visual mechanisms. I. A visual discriminometer. II. Threshold stimulus intensity and retinal position. Jour. Gen. Physiol., 1939, v. 22, p. 341.
[24d] ———. Theory and measurement of visual mechanisms. III. Δ I as a function of area, intensity, and wavelength for monocular and binocular stimulation. Ibid., v. 23, p. 101.
[25] Jackson, E., Black, N. M., Ewing, A. E., Lancaster, W. B., and Fagin, R. Report of committee on standardizing test cards for visual acuity. Trans. Sect. Ophth., Amer. Med. Assoc., 1916, p. 383.

DROUGHTS AS FACTORS IN THE DEVELOPMENT OF SENILE CATARACT*

P. W. SALIT, PH.D.

Iowa City, Iowa

In the work on the chemistry of human cataractous lenses at the Ophthalmological Research Laboratory of the State University of Iowa, sudden pronounced increases in the cataract incidence were noted during the years 1935 and 1937, just following the two most severe drought years, 1934 and 1936, of recent times. This led to a comparative statistical study of all adult patients who had a diagnosis of cataract at the eye clinic of the State University of Iowa during the last 29 years; that is, beginning with 1911 and ending with 1939 (table 1).

Male patients in this study were represented chiefly by laborers and farmers, and female patients by housewives. Practically all had cataracts in both eyes, and came to the eye clinic several times for treatment, but only their initial appearance at the clinic is counted; that is, the number of cataract cases is based on the number of individual patients, and not on the number of cataract extractions or other treatments for cataract. The total number of adults who had received cataract treatments at the eye clinic over the period of 29 years was 1,863. Of these, 1,152 were men, and 711 were women.

In conjunction with the study of the incidence of cataract, a statistical study of the weather conditions as reported during the last 29 years for the state of Iowa by the U. S. Weather Bureau at Des Moines, Iowa, was also made. It was found that similar droughts occurred also immediately before and to a lesser extent during certain other high points of cataract development; that is, during the summers of 1913-1914, 1921-1922-1923, and 1930-1931.

The peak in the cataract frequency, as a rule, coincides with the year following that of the drought, as it takes some time for the damaging influence to bring about the results. In such cases the high points of the drought period of the preceding year occur, on the whole, in the spring (1934) or the early summer (1913, 1936) and extend more or less throughout the summer, and the cataract frequency of the following year is shifted more or less toward the fall or the latter part of the year (1935, 1937). In other cases the drought is of less intensity, but extends over a longer period of time, so that the

* From the Department of Ophthalmology, College of Medicine, State University of Iowa.

TABLE 1

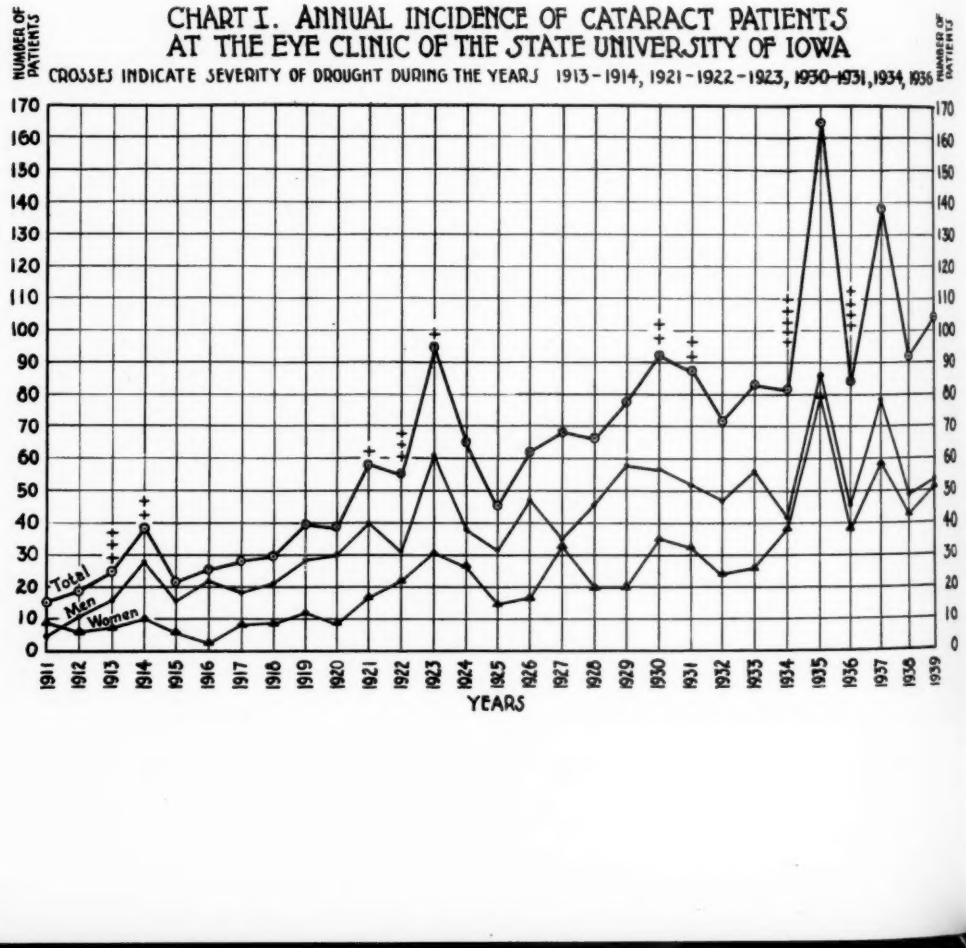
CATARACT PATIENTS TREATED AT THE EYE CLINIC OF THE STATE UNIVERSITY OF IOWA DURING THE PERIOD OF 1911–1939

Year	Sex	Range of Age	Aver. Age	No. of Patients	Ratio of Women/Men	Total Number
1911	Women	29–76	55.5	9	1.500*	15
	Men	39–67	53.7	6		
1912	Women	26–67	48.5	6	0.545	17
	Men	23–81	60.0	11		
1913	Women	21–75	59.3	8	0.500	24
	Men	30–84	60.4	16		
1914	Women	24–84	60.0	10	0.357	38
	Men	20–89	58.7	28		
1915	Women	20–77	42.8	5	0.313	21
	Men	20–84	59.2	16		
1916	Women	61–79	70.0	3	0.132	25
	Men	33–72	53.8	22		
1917	Women	21–83	58.1	8	0.421	27
	Men	20–78	58.9	19		
1918	Women	45–72	64.0	9	0.429	30
	Men	27–80	60.4	21		
1919	Women	24–82	63.1	12	0.429	40
	Men	25–85	64.7	28		
1920	Women	47–84	64.0	9	0.300	39
	Men	21–87	57.3	30		
1921	Women	30–74	61.3	17	0.425	57
	Men	20–85	61.2	40		
1922	Women	29–76	60.1	22	0.710	53
	Men	32–88	63.5	31		
1923	Women	32–80	61.6	32	0.500	93
	Men	29–93	64.3	61		
1924	Women	26–81	59.7	27	0.711	65
	Men	30–84	64.0	38		
1925	Women	25–78	61.2	14	0.438	46
	Men	21–84	59.8	32		
1926	Women	30–75	62.7	16	0.341	63
	Men	24–88	65.0	47		
1927	Women	33–82	61.4	34	0.971	69
	Men	20–83	60.7	35		
1928	Women	54–83	69.1	20	0.435	66
	Men	39–87	69.8	46		
1929	Women	23–85	64.7	20	0.345	78
	Men	20–90	62.8	58		
1930	Women	30–85	63.0	35	0.612	92
	Men	30–85	65.9	57		
1931	Women	26–85	63.2	33	0.623	86
	Men	23–95	66.4	53		

TABLE 1—*Continued*

Year	Sex	Range of Age	Aver. Age	No. of Patients	Ratio of Women/Men	Total Number
1932	Women	39–79	64.0	24	0.511	71
	Men	29–88	64.7	47		
1933	Women	45–83	70.7	26	0.456	83
	Men	33–85	66.7	57		
1934	Women	39–82	64.6	39	0.951	80
	Men	49–87	70.0	41		
1935	Women	33–87	67.6	80	0.930	166
	Men	41–85	68.2	86		
1936	Women	44–79	67.1	39	0.867	84
	Men	49–86	68.1	45		
1937	Women	48–87	67.2	59	0.747	138
	Men	50–87	70.0	79		
1938	Women	47–88	69.1	43	0.878	92
	Men	50–87	73.0	49		
1936	Women	46–80	67.1	52	0.981	105
	Men	45–86	70.6	53		

* By multiplying the figures of this column by 100, the percentage ratio of women to men is obtained.



high level of cataract frequency is reached within two (1913-1914) or three (1921-1922-1923) consecutive drought years. In 1930 the high points of the drought period fell in the spring and summer, and there was time for the cataract frequency to reach its climax before the expiration of the year. But the following year, 1931, there was a repetition of the drought, reaching its high level in early summer and continuing at that level throughout the rest of the summer and the early fall. Consequently the incidence of cataract was rather high for the two consecutive years (chart I).

Considering the wide differences in the degree and distribution of the high points of the droughts of the various years as well as the differences in the time periods which the individual cataract patients allowed to elapse between the time of failing vision and the operation, the coincidence between cataract frequency and summer droughts is remarkable. It clearly shows what an important part radiant energy as well as heat and winds and atmospheric humidity play in the production of cataract.

Senile cataract and sclerosis are the cumulative results of the injurious effects of various endogenous and exogenous agencies received by the lens in the course of several years. The different injuries in themselves, at the moment of their occurrence, do not produce lesions in any way resembling a cataract or sclerosis; they only initiate or hasten a progress leading eventually to disintegration of the lens tissue. It is quite in harmony with this fact that the high points in cataract incidence do not exactly coincide with the high points in drought, but appear as a rule a few months later. This also means that the increase in cataract incidence for which the droughts appear to be responsible is not altogether due to drought—that is, the latter did not produce a fully developed cataract in a sound normal lens, but only hastened its development when there was already a small lesion or started a lesion which eventually might lead to cataract and sclerosis.

The fact that the number of female patients constitutes, on the average, only 38.2 percent of the total number of the cataract patients must be attributed largely to the differences between the occupations of the two sexes. As already pointed out in the beginning, the female clientele was represented chiefly by women who were engaged in ordinary housework. On the other hand, most of the men who came to the eye clinic for cataract treatment worked under conditions in which they often received more or less severe blows on the face or the head, were exposed to the radiant energy, heat, and various gases from furnaces and acetylene torches as well as the intense sunlight, dust, wind, and the extreme changes in temperature and humidity of the open spaces or the poisonous carbon-monoxide gas of the garages and machine shops.

Besides the periodic sudden increases in the cataract incidence due to droughts, there is also an increase of a more general nature in the number of cataract patients from year to year. This is evidently due to the development of the eye clinic at the State University of Iowa from a subdivision of the eye-ear-nose-and-throat department, such as it was in 1925, to an independent eye department as well as to the increased efforts on the part of the staff members in the dissemination of medical knowledge among laymen concerning the care of the eye.

Summary

Sudden marked increases in the cataract incidence were found to have occurred at the eye clinic of the State University of Iowa during the periods of 1913-1914, 1921-1922-1923, 1930-1931,

1935, and 1937; that is, immediately following or during the state-wide drought periods as reported by the U. S. Weather Bureau for the State of Iowa for the last 29 years.

In all, 1,863 adult patients with cataracts had been seen during this time. Of these, 1,152 were men and 711 women.

It is concluded that some of the agencies responsible for senile cataract consist in such factors as prolonged exposure to intense sunlight, dust, winds, and extreme changes in temperature and humidity of the open spaces.

Cataract is much more frequent among men than women, the latter constituting, on the average, only 38.2 percent of the total cases during the 29-year period. This, apparently, is due to the differences between their respective occupations, men, such as farmers and laborers, being more exposed to the harmful agencies than women, who were largely engaged in housework.

LOCAL TREATMENT OF GONORRHEAL CONJUNCTIVITIS WITH SULFANILAMIDE POWDER*

PHILIPPE PANNETON, M.D.
Montreal

It can be said with reason that gonorrheal conjunctivitis (purulent ophthalmia) has been the great source of patients for hospitals for the blind. Actually, its malignancy, tenacity, and especially the ease with which it causes irreparable corneal lesions, render the disease particularly serious.

The use of silver salts, and especially of argyrol, since its general adoption, has produced better results than former inadequate treatment; and, with patience and fairly strong solutions, cures of not too virulent infections can be obtained. Unfortunately, it often happens that even when the case is taken in good time and treated drastically the conjunctivitis becomes a keratitis; even under the very eyes of the nurses and doctors, the normal eye becomes a hideous thing to observe, and from then on becomes a source of danger.

The invention of the organic derivatives of sulphur has given rise to many high hopes and possibilities. After encouraging results were obtained in the treatment of urethritis by means of sulfanilamide tablets it was but a short time before gonorrheal conjunctivitis began to be treated with this drug.

Unfortunately, there were numerous patients who had serious reactions from the ingestion of this drug, the least of which were nausea and vomiting. Furthermore, in order to obtain results from the ingestion of the drug it is necessary to give a dose which approaches the threshold of tolerance, and this becomes a source of anxiety.

Very soon numerous physicians began to treat this type of conjunctivitis directly with sulfanilamide solutions in the form of irrigations and frequent instillations. However, the sulfanilamides are not readily prepared in concentrated solutions. They are soluble in warm, salt water; nevertheless, it is still difficult to prepare stable solutions of more than 1 percent.

I have used this solution to advantage. For nearly four years, until this year, it was by this method that the little patients of the Creche d'Youville were

* From the Department of Ophthalmology, Notre Dame Hospital.

systematically treated. Fewer and fewer of these cases are now seen there. It may be asked, in passing, whether the treatment and rapid cure of the urethritis by this new chemotherapy is not the cause of the decreased frequency of this disease, which certainly was formerly much more prevalent.

Treatment by instillation of the drug into the eyes had given encouraging results; at least, there was progress, if the duration and effectiveness of the treatment could be compared with the results obtained from the old classical treatment with silver salts.

Finally, one day, a patient presented himself who appeared to have a particularly virulent infection, if the amount of purulent discharge could be taken as a criterion. In view of this case, I had the idea of a new method of treatment which, on the following rationale, appeared to be a better method of procedure.

The sulfanilamides have a remarkably effective and indisputable action on the gonococcus *in vitro*.

In vivo, the solution of sulfanilamide is effective in inverse proportion to the dilution of the drug in the blood stream.

Furthermore, the substance itself is not irritating to the mucous membrane or but very slightly so.

The essential idea now was to expose the organism, which is situated in the conjunctival sac, directly to the drug. The question arose: (1) Why take a circuitous route, that is, by mouth, to attack an organism in a region that is directly accessible? (2) Why use a solution, since the tears themselves, which consist of warm salt solution, could very well dissolve the drug placed in powder form on the inner surface of the lids. As a precaution, before instituting the treatment on the patient, it seemed preferable to make a trial *in anima vili*. Some of the sulfocide* powder was placed in the conjunctival sac of my own eye. This gave me a sensation of dust or tiny foreign bodies in the eye, which lasted some 10 minutes. After this simple experiment, the eye felt and looked perfectly well.

It was only after this experiment that the treatment was instituted on the patient. Approximately 30 centigrams were placed in each eye. The course of the disease from this point on will be found in the notes below, which speak for themselves, and make further comment unnecessary.

Lest the rapid improvement of these patients be considered due, in part, to enthusiasm, let it be remembered that these notes are simple transcriptions from the case reports, which consist of the daily notes made by the nurse in charge, and are not my own observations.

I am greatly indebted to our excellent colleagues Dr. Jean Mignault, of l'Hopital St. Justine, and Dr. Marcel Ostiguy, first ophthalmologist at l'Hopital Pasteur, Hospital for Contagious Diseases in Montreal, as well as to the superintendent of this institution, Dr. Charbonneau. Dr. Charbonneau graciously gave me access to the beds and records, and his hospital was the one in which I could find cases of gonorrheal conjunctivitis. The second of the patients mentioned below was treated by Dr. Mignault.

We would have had only two cases to present if Dr. Marcel Ostiguy had not generously allowed us to see and publish the results of the eight cases that he himself treated by our method. He carried on this treatment as a result of our discussion at a meeting of the Société Médicale de Montreal in March, 1940.

Dr. Ostiguy, furthermore, added to the general idea of the treatment certain details in the technique which are of great importance; namely, the use of a pulver-

* Sulfocide as well as streptocide, used in another case, is a trade name for a chemical compound of the sulfanilamide series.

izer for the purpose of placing the powder in the eye. This provides for better and more even instillation of the powder and also keeps it sterile while it is being placed in the eye. Furthermore, on his suggestion, the commercial house which had generously furnished the streptocide consented to make up the specially prepared drug in the pure state.

Thanks to the excellent coöperation received, I can now present 10 cases which would seem to justify our enthusiasm. The confirmation of our hopes came from a colleague who followed the suggested treatment only for the purpose of verifying the results which I had claimed in my first case.

Case histories

Case 1. Rene C., aged 25 years, was first seen on December 29, 1939, because of an acute suppurative inflammation of the eyes. On December 8th, this young man noted the first symptoms of an acute urethritis, which, during the following days, took on the classical characteristics of blennorrhagia. Until the 27th the course of this disease was usual, and he was given the classical local treatment by his doctor.

On the 26th, he noticed inflammation of the eyelids and tearing of the eyes. On the 27th the inflammation increased, and at the same time there developed an acute pain in the left ankle. A mild fever appeared shortly afterwards, and then the symptoms increased rapidly.

At the time of the consultation, the afternoon of the 29th of December, the eyes showed the characteristics of an early gonococcal purulent ophthalmia. The eyes were red, the lids slightly swollen. The purulent discharge, slightly yellow, was so abundant that it was necessary for the patient to wipe it away continuously. Literally, he cried pus.

There was no chemosis as yet, although traces had begun to appear in the fornices. The cornea was clear.

In view of the purulent ophthalmia, the arthritis, and the acute urethritis, but one diagnosis was considered possible: gonorrheal conjunctivitis.

The patient was admitted immediately and treatment begun. Lavages, every two hours, were prescribed and a solution of mercuric oxycyanide 1:10,000 every two hours. Every half hour a large and repeated instillation of a 2-percent solution of sulfanilamide was made, this being the treatment that had given fair results at the Creche d'Youville, as has already been stated. At the same time the patient received, seven times a day, 0.50 centigrams of a similar product by mouth. Finally, ice compresses were applied. The next day, "abundant secretion" was reported. The redness had not diminished and the pus was no thinner.

It was during my noonday visit that the idea occurred of applying the powder directly to the eye. It was first tested on my own eyes to make sure that it was not irritating; then, with a spatula, a certain quantity of sulfocide powder was deposited on the cornea and in the fornices. The patient stated that he felt no irritation. This was ordered done every two hours, after washing with a solution of oxycyanide 1:10,000.

All other medication was stopped. The same evening the nurse reported less abundant pus. The following noon, December 31st, approximately 24 hours later, to my astonishment, it was found that the discharge had stopped completely. In the afternoon the nurse confirmed the fact that there had been complete absence of abnormal discharge. The two eyes were still a little red, but the patient stated that he felt that his eyes were practically cured.

In the meantime, the urethritis continued to develop as well as the arthritis,

which had become polyarthritis. This, again, confirmed the diagnosis as well as the virulence of the organism.

From that moment, *there was no more pus* in the eyes nor any abnormal secretion.

On the fourth day the treatment was discontinued and, as a precautionary measure against possible recurrence, argyrol was prescribed for instillation into the eyes.

On the seventh day the patient was discharged, his eyes completely cured, and sent for care of his polyarthritis, which had remained extraordinarily tenacious.

Case 2. J. P., a 10-year-old girl, was admitted on April 11th to l'Hopital Sainte Justine, by Dr. St. Onge, to the service of Dr. Jean Mignault. For the past 10 days the child had complained of discomfort in the right eye, as if dust were in the eye. Following this an inflammation appeared, then redness and edema.

The first examination showed the right eye to be very inflamed. The lids were swollen, and chemosis was marked. The palpebral conjunctiva showed numerous granulations and, in the fornices, a fold which resembled an edematous cockscomb. The pus was profuse, yellow, and sticky.

The left eye was normal.

Classical treatment was begun at once: ice packs, washes, irrigations of potassium permanganate 1:10,000, and instillations of 25-percent argyrol, every half hour; one-half tablet of sulfanilamide (Dagenan) every half hour.

On the 12th of April the condition remained the same and the cornea began to appear milky. The laboratory report on the smear next day, was doubtful as to the presence of gonococci.

An ulcer had already developed, and covered about one fifth of the cornea. On April 14th, there was a little less pus. The next day there was profuse pus. The corneal ulcer showed a yellow tint, of serious portent. On April 16th, the symptoms remaining the same, heat was applied directly to the cornea. The tablets were discontinued.

On April 17th, there was profuse pus. The left eye remained normal. The chemosis had diminished slightly, but examination was difficult because of the swollen lids. The palpebral conjunctiva formed several folds, long cockscombs. The ulcer had extended slightly.

I saw the child on April 18th, in consultation with Dr. Mignault, and suggested sulfapyridine treatment. All other treatment was stopped except the powder in the eye every hour daily, every four hours at night. There was less pus the next day, and a noticeable decrease in the edema. The laboratory report on a specimen taken on the 17th was positive for gonococci.

On April 21st there was a marked decrease of pus and edema. The ulcer appeared to be improving and beginning to form scar tissue; the lids were beginning to open. On April 23d very little pus was seen. It was decided to alternate sulfanilamide and argyrol. In an attempt to speed the slow shrinking of the cockscombs, 1-percent silver nitrate was applied once a day.

On April 26th, the ulcer was cured, and the redness had practically disappeared. The patient could now open the eye wide. There was a small amount of secretion in the mornings. Three days later, no secretion was noted. On the morning of May 3d the lids were slightly adherent. The cockscomb had almost completely disappeared. The patient was discharged on May 21st. There remained only a thin corneal scar. Her condition was normal.

Following the suggestions made at the meeting of the Société Médicale de Mont-

real, Dr. Marcel Ostiguy, of l'Hopital Pasteur (Contagious) decided to try the treatment.

Case 3. Real D., aged 8 days, was admitted for conjunctival infection of several days' duration. Both eyes were red, injected, and discharging—frank pus from the left eye, yellow and profuse.

Examination of the smear was negative, but the clinical diagnosis was obvious. Classical treatment followed: ice packs, 25-percent argyrol, irrigations, and so on, every three hours.

On March 6th there was profuse suppuration. A heavy edema developed. The following day the suppuration was increased as well as the chemosis. The right eye also began to suppurate.

March 8th. The chemosis was increased in spite of careful treatment given by experienced nurses.

March 9th. No improvement was found. Chemosis continued and profuse pus in both eyes. The cornea of the left eye became involved, and the eye looked very bad. Furthermore, the conjunctiva of the left eye showed a tendency to ulceration in the inferior fornix.

March 10th. There was slightly less edema. A paracentral ulcer developed on the cornea of the left eye. Atropine was added to treatment.

March 14th. The edema and pus were slightly diminished, but the ulcer continued to develop.

March 15th. Very little pus was noted.

March 16th. Bilateral otitis had developed. Bilateral paracentesis was done. The ulcer had deepened and the condition of the eyes remained bad.

March 20th. Excoriation appeared on the lower lids. That evening, in the course of treatment, the cornea (O.S.) ruptured at the site of the ulcer. The lens was expressed. There was extensive hemorrhage through the rupture. A pressure bandage was applied.

April 8th. The inflammation persisted in spite of treatment. There was pus, although only a slight quantity.

April 19th. The condition was unchanged, with slow healing of the cornea.

April 27th. Frank pus was found in left eye, with secretion in the right eye as well. Applications of argyrol at three-hour intervals were ordered.

April 28th. A large quantity of pus drained from the left eye; the cornea of the right eye was normal.

Because of this tenacious infection, we felt that treatment with sulfanilamide powder was indicated. The streptocide was insufflated into the eye by means of a pulverizer once every hour.

April 29th. Pus was present.

April 30th. No pus for the first time in eight weeks. This disappearance was definite; every day the record showed: no pus. The cornea was healing rapidly.

May 10th. The ocular condition was good, healing complete. There was no more redness, excoriations, edema, nor discharge.

Unfortunately, a staphyloma remained, covering practically all the cornea. This staphyloma was the result of the rupture which occurred on March 20th, before streptocide treatment was instituted.

Case 4. Andre L., aged 10 days, was admitted on March 14th to l'Hopital Pasteur, service of Dr. Ostiguy, with gonorrheal conjunctivitis. The smear was positive for gonococci.

The left eye showed redness and the discharge of a moderate quantity of yellow pus. There was no chemosis. The right eye was slightly red.

Classical treatment was prescribed: argyrol, ice compresses.

March 17th. No improvement of any kind was found, and the right eye then showed definite infection and suppuration; profuse pus from the left eye.

March 26th. More or less profuse pus

was found from day to day, but no great improvement.

March 28th. Very profuse pus contined to flow from both left and right eyes.

April 2d. There was very little pus.

April 3d. A recurrence of pus from both eyes was noted, with redness and slight edema.

Until April 25th the same condition prevailed, without much indication of immediate improvement. The amount of pus varied from day to day. On April 26th streptocide insufflation was started. The next day there was no pus, no abnormal discharge, apart from slight redness, and tearing.

From that date there was no recurrence.

Case 5. Rejean C., aged 9 days, was admitted on May 6th to l'Hopital Pasteur, service of Dr. Ostiguy, because of gonorrheal conjunctivitis.

Profuse yellow pus flowed from both eyes, which were red. The examination of the cornea was inadequate because of pronounced chemosis.

The smear was negative for gonococci. The usual treatment (see cases 3 and 4) was instituted.

On May 7th there was increased edema, with abundant pus. The condition persisted for two days.

On May 11th, the edema was slowly diminishing. The cornea of the left eye was white and infiltrated; pus was very profuse in this eye.

May 14th. Excoriations developed in the palpebral conjunctivae; these also developed on the cutaneous surface of both left and right lids, with bleeding at the dressings. Zinc-oxide ointment was applied.

May 17th. There was a slight diminution in the quantity of pus, but the cornea was ulcerated.

On May 22d the ulcer had progressed and a herniation of the iris appeared. Atropine was prescribed. A moderate amount of pus was present.

At this time it was decided to discontinue argyrol and institute insufflations of sulfanilamide powder (Dagenan).

May 23d. No pus was observed, but a notable improvement in the corneal lesions and the ocular symptoms in general. The edema had diminished considerably and the cutaneous ulcerations were of good color.

May 24th. Definite cicatrization of the cornea had appeared. There was very little discharge.

May 29th. No sign of any real pus.

May 30th. The edema had completely disappeared. The palpebral lesions and the cornea were completely healed.

June 6th. The ocular condition was normal, except for a semitransparent corneal scar and an anterior synechia.

Case 6. Andre R., aged 6 days, was admitted on May 21st to l'Hopital Pasteur, service of Dr. Marcel Ostiguy, because of gonorrheal conjunctivitis.

The left eye showed moderately profuse pus. Redness had been present for three days, and, since the preceding day, frank pus. The smear was negative for gonococci.

In view of the above successes, Dr. Ostiguy, in all confidence put aside the classical treatment and immediately instituted the new treatment of insufflation of streptocide powder directly into the eyes, this being done every three hours, following irrigation with a solution of mercuric oxycyanide 1:10,000. The only additions were ice packs and wet compresses. On May 22d the pus was less profuse. The following day no pus was apparent. On May 24th there was a slight purulent discharge, but on the next day there was complete disappearance of pus and discharge, with no further recurrence.

Case 7. Ulric D., aged 65 years, on May

18th was admitted to l'Hopital Pasteur, service of Dr. Ostiguy, in a pitiful state.

Accompanying an acute urethritis was a maximum purulent ophthalmia. From both eyelids there flowed thick, yellow pus. The chemosis was extreme, and the conjunctiva protruded between the lids. The lower lids were the site of an inflammation resembling erysipelas, but in reality there were two abscesses, from which fistulae discharged pus. At the first washing, the lids bled. The smear was positive for gonococci.

Immediately treatment by insufflation of streptocide every three hours was instituted.

On the following day the pus appeared less profuse. The edema was definitely diminishing.

May 20th. The edema had practically disappeared. No pus was found. The patient had been treated only 48 hours, and he was already able to open his eyes.

May 21st. There was a slight discharge from the eyes (very slight); no more edema.

May 23d. The discharge had disappeared from the eyes, and the lids showed no more pus.

May 25th. A slight edema and redness of eyes were all that remained from this very acute case. On May 27th the palpebral scabs sloughed off.

This was the only case in which, in addition to local treatment, we gave Dagenan by mouth; but not before the 19th of May when already there was an improvement of the eyes. Oral treatment had to be instituted on account of the urethritis, which was accompanied by cephalitis and fever. The dosage by mouth consisted of 6 grams on the 19th; 3 grams a day for three following days and for the next 8 days, 2 grams.

Case 8. Jean-Paul G., aged 11 days, was admitted on May 28th to l'Hopital Pasteur, service of Dr. Marcel Ostiguy, with gonorrheal conjunctivitis.

Both eyes showed yellow frank pus, redness of the globes, and chemosis. The smear was negative for gonococci.

Without delay, this patient was put on direct streptocide treatment. In 12 hours there was complete cessation of pus and discharge.

In 24 hours the chemosis had disappeared. In 36 hours the eye was perfectly normal.

Case 9. Liliane D., aged 13 days, was admitted on May 31st to l'Hopital Pasteur, service of Dr. Marcel Ostiguy, with gonorrheal conjunctivitis.

The right eye showed moderately profuse yellow pus, redness of the globe, and slight chemosis. The left eye showed slight chemosis and secretion. The smear revealed pus with polymorphonuclear leukocytes, but no organisms.

This little patient was put immediately on the new treatment with streptocide. It must be kept in mind that before her admission she had been treated with silver salts, as well as having been given prophylactic treatment at birth, as was the case in all the newborn reported here. This explains the frequent absence of gonococci in the smears taken to the laboratory.

The following was prescribed: Insufflation of streptocide powder directly into the eye every three hours, the only addition being ice and wet dressings as used in the other cases. Argyrol was used only for the nose, for a mild coryza.

In 12 hours there was no pus nor discharge. At most there was slight redness and edema.

On June 2d, 48 hours after admission, there remained nothing of a pathologic nature. On June 5th the condition was normal.

Case 10. Therese V., aged 2 days, had been treated on June 3d, before being admitted to l'Hopital Pasteur, service of Dr.

Marcel Ostiguy. At that time the eyes were red and there was frank yellow pus in both eyes, but only a small quantity.

On June 4th the patient was admitted. She was found to be suffering from vaginitis. A smear from the eyes was negative.

Direct insufflation with streptocide, every three hours, after washing with mercuric oxycyanide, was immediately instituted. On June 5th there was very little pus. No pus was found on the next day and none since. No further symptoms were observed.

It does not seem necessary to stress the point. Let me repeat: 9 of these 10 reports are from hospitals on the staff of which I am a member. My colleagues made a careful test of the new method, and the daily notes, which are here transcribed, were entered by the nurses on duty.

Nevertheless, it would be well to draw attention to a few points:

(1) The rapidity of the results.

For the 10 cases treated, this table gives the interval after which pus disappeared, then all discharge.

Attention is called to the fact that in the third column I have made note of all secretion, however slight.

This table does not mention the gravity of several cases. It is necessary to refer to the individual history to realize how serious certain infections were.

Finally, it is to be noted that the patient in case 1 was treated with sulfocide; in cases 2 and 5 with sulfapyridine; the others with streptocide. The small number of cases prevents a comparison of the three products.

Case No.	Pus disappeared (days)	Secretion disappeared (days)
1	2	2
2	6	
3	2	
4	1	
5	1	7
6	2	4
7	2	5
8	½	
9	½	
10	2	

(2) We know that elsewhere the course of the disease has been followed by examining smears; which is certainly more scientific. But, for one reason or another, the examination of the smears gave positive results in only two cases. Otherwise, the diagnosis was sufficiently obvious clinically to class these cases as acute gonorrheal conjunctivitis; the doubtful cases were not here included.

In this paper I desire to draw the attention of my fellow ophthalmologists to a method of treatment, the efficacy of which, I believe, will be demonstrated in the future.

With such results, and from the simplicity of the treatment, I am led to believe that from now on it will be possible for a practitioner to treat this terrible infection effectively with a drug that will be always at hand and the application of which is extremely simple.

Notre Dame Hospital.

NOTES, CASES, INSTRUMENTS

A CORNEOCONJUNCTIVAL KNIFE AND A COUNTERPRESSER FOR USE IN EYE SURGERY

WILLIAM D. GILL, M.D., F.A.C.S.
San Antonio, Texas

The instrument shown in the accompanying illustration was designed to facilitate turning down the conjunctival flap preparatory to performing the tre-

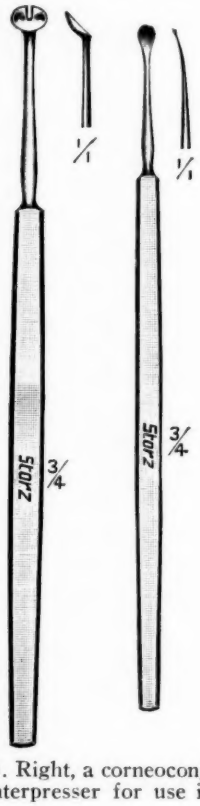


Fig. 1 (Gill). Right, a corneoconjunctival knife. Left, a counterpresser for use in eye surgery.

phine operation of Elliot. With the usual methods employed in preparing such a flap, a perforation may be very easily made at the base of the flap where it joins the corneal tissue proper. This is particularly true in the case of elderly persons who have extremely friable tissues. The instrument that has been devised for this purpose is used to complete the dissection of the flap when it reaches the limbus. The separation is easily accomplished by side to side motions of the knife as the rounded cutting surface is in contact at all times with the tissues and the curve of the blade is such that the instrument adapts itself to the corneal curvature and minimizes the danger of perforating the flap. The dissection is a sharp one and is therefore accompanied by little postoperative reaction. The knife may be used for other operations on the eye, such as the removal of a pterygium, or in any operation in which a conjunctival flap must be dissected.

The instrument shown on the left in the accompanying illustration was designed to facilitate the passage of a needle through tough tissues such as the cornea and sclera, and has proved to be a valuable aid in placing sutures in these tissues. The extremity of the instrument is cupped to adapt itself readily to the curve of the eyeball and is slotted in such a manner that it may be used to stabilize the structure being sutured by permitting the needle to be passed through the slot in its extremity. The metal on either side of the slot presses against the tissues on either side of the needle puncture and permits passage of the needle without excessive drag being applied to the eye. This is of great assistance in suturing corneal and scleral wounds, and facilitates the placing of sutures in operations such as corneal transplants.

323 Medical Arts Building.

WEVE DIATHERMY ELECTRODE

A NEW MODIFICATION

RALPH O. RYCHENER, M.D.
Memphis, Tennessee

This electrode is designed to induce scleral coagulation in the treatment of separation of the retina.

The contact point has been reduced to a diameter of 1.5 mm. from the original 2-mm. point that delivers a coagulating current over a wider area than is sometimes desirable.

The electrode has been curved to the scleral radius, which permits easier access to any area of the globe, even to

Fig. 1 (Rychener). Modified Weve diathermy electrode.

the macula, if necessary. The instrument can be placed accurately by insertion under the extraocular muscles, and it is conceivable that by its use fewer muscles will require temporary disinsertion.

For purposes of accuracy, when the electrode is applied to a visible area, the center of the contact point is indicated by a red dot on the superior surface of the electrode. Similarly, circular markings are placed at 8-mm., 13.5-mm., and 18.5-mm. distances from the proximal edge of the contact point to indicate the respective positions from the limbus of the ora serrata, the equator, and the anterior boundary of the zone of the venae vorticosae. By placing the electrode in contact with the limbus, one may readily determine the exact position of the point in contact with the sclera, even though the tip of the electrode is inserted under a muscle or Tenon's capsule.

The markings to designate the boundary lines of the ora serrata and venae vorticosae are red; the marking for the equator of the globe is yellow, as are also the lines for each additional 5 mm.

1720 Exchange Building.

TRANSIENT MYOPIA DURING SULFANILAMIDE THERAPY

D. P. Hornbogen, M.D.
Marquette, Michigan

The advent of sulfanilamide and related compounds has opened a new era in the therapy of infections. As is to be expected of such a potent remedy, it has various side actions, some of which are well known, and others little understood. Reports of the appearance of ocular complications from its administration have been exceedingly few. Gailey[1] reports a case of transient myopia during sulfanilamide therapy which he attributes to edema of the crystalline lens, and Spellberg[2] cites a case which he attributes to edema of the retina. A case of optic neuritis has been reported by Bucy.[3] The following case is reported to add to the literature on this subject:

A white female, 28 years of age, a school teacher, was seen on June 6, 1939, complaining of blurred vision of 24 hours' duration. The previous day, while driving an automobile, her vision became blurred over a period of a very few minutes and this had persisted at approximately the same level. She had been receiving 40 gr. of sulfanilamide daily for 14 days, a total of 560 grains (37 gm.), for a suspected pelvic infection.

Examination: Vision in the right eye was 15/300. The conjunctiva was chemotic, the cornea clear; the anterior chamber was clear and of normal depth. Iris and pupillary reactions were normal, the lens and media clear, and the disc, retina, and choroid normal. The intraocular tension was 18 mm. Hg.

Vision in the left eye was 12/300; otherwise the conditions were similar to those found in the right eye.

Manifest refraction showed: R.E., with a −4.50 D.sph. vision increased to 20/30; L.E., with a −5.00 D.sph. ⊂⊃ −1.50 D.cyl. ax. 70°, vision was 20/20. Refraction under homatropine cycloplegia gave the same results. Visual-field studies were normal. Urinalysis was negative. A blood-sugar test was not made.

The sulfanilamide was discontinued, and on June 7th the condition was unchanged. On June 8th, improvement in vision was noted: R.E., 20/50, improved

to 20/20 with a −0.75 D.sph.; L.E., 20/100, improved to 20/20 with a −1.00 D.sph. It is interesting to note that the astigmatism of the left eye had entirely disappeared. By June 10th, uncorrected vision was 20/15 in each eye.

At the suggestion of the referring physician sulfanilamide was resumed. Sixty grains daily were given for the next four days, a total of 240 grains (16 gm.), at which time the vision was still normal, and the drug was discontinued. No further visual symptoms developed.

This sudden refractive change is best explained as being due to an edema of the crystalline lens. The chemosis of the bulbar conjunctiva definitely indicates a change in the water balance of one ocular structure at least, and the sudden appearance and disappearance of 1.5 diopters of astigmatism in the left eye could be best explained by a swelling of the lens rather than any change in the refractive index of the other media.

401 Savings Bank Building.

References

Gailey, W. W. Transient myopia from sulphanilamide. Amer. Jour. Ophth., 1939, v. 22, no. 12, p. 1399.

Spellberg, M. A. Toxicity of sulphanilamide. Illinois Med. Jour., 1939, v. 75, no. 4, p. 366.

Bucy, P. C. Toxic optic neuritis resulting from sulphanilamide. Jour. Amer. Med. Assoc., 1937, v. 109 (Sept. 25), p. 1007.

SOCIETY PROCEEDINGS

Edited by Dr. H. Rommel Hildreth

CHICAGO OPHTHALMOLOGICAL SOCIETY

January 15, 1940

Dr. Earle B. Fowler, *president*

The clinical significance of retinal and choroidal arteriosclerosis

Dr. Henry P. Wagener stated that exclusive of the lesions due to local inflammatory or occlusive disease, most of the changes in the retinal arterioles commonly designated as "sclerosis" are associated with hypertensive disease. Not all the changes visible ophthalmoscopically in the arterioles have an organic histologic counterpart. Localized constrictions of the lumens of the arterioles seen in patients with hypertensive toxemia of pregnancy and acute vasospastic hypertensive disease are unquestionably due to angiospasm, possibly caused by a vasopressor substance circulating in the blood stream, which may relax without leaving structural changes in the walls of the arterioles. These angiospastic lesions seem to represent the more serious and progressive features of the hypertensive disease. It seems more logical to assume that "retinitis" represents an acute decompensation of the retinal circulation as the result of severe but not occlusive spasm of the arterioles than that it is the result of actual sclerosis or necrosis of the terminal arterioles in the retina. The theory of circulatory decompensation seems certainly to explain better the episodal character of the retinitis in many patients with progressive hypertensive disease.

As a result of persistent elevation of blood pressure, the wall of the retinal arteriole, especially the medial coat, tends to hypertrophy. This wall thickening is visible ophthalmoscopically as a change in the color of the vessel to a coppery or silvery hue and as arteriovenous compression. This type of change may be designated as chronic arteriosclerosis, since it is associated with the duration rather than with the severity of the hypertensive disease.

In many or most cases of primary hypertension of long duration, localized narrowings of the lumens of some of the arterioles are associated with the evidences of chronic sclerosis. Usually these indicate previous angiospastic episodes, the hyaline or lipoid degeneration of the arteriolar wall at these points being explained possibly by poor nutrition of the wall at the point of a long-continued or recurrent spasm. When these localized angiospastic narrowings continue to recur or to increase in number, and especially when they are associated with retinitis, it becomes obvious that the hypertensive disease has assumed a serious and progressive nature. It is possible to show a definite difference in prognosis for the groups of hypertensive disease with and without evidences of recurrent or continued angiospasm.

The retinitis seen in association with chronic glomerulonephritis represents the same circulatory decompensation of the retina as that which occurs in primary hypertension. It will assume the acute angiospastic type without chronic sclerosis of the retinal arterioles, or the "malignant" hypertensive type with chronic sclerosis of the retinal arterioles, according as the glomerulonephritis is not or is complicated by the presence of sclerosis in the renal arterioles and diffuse arteriolosclerosis.

Sclerosis of the choroidal arterioles is usually a senile change. It is not definitely indicative of a corresponding change in the coronary, cerebral, or peripheral vessels. Statistical overlapping of arteriosclerosis in these various locations would seem to depend largely on the fact that all these forms of arteriosclerosis tend to occur in the same age groups. It is of interest that cardiac symptoms are complained of by a high percentage of individuals, below the age of 50 years, in whom choroidal arteriosclerosis is visible. In only a few of these, however, can it be demonstrated that the symptoms have an organic basis at the time of the initial examination. The choroidal arteriosclerosis seen in patients with hypertensive retinitis is not of the usual senile type. It tends to affect individual vessels rather than vessel groups and may represent a postangiospastic sclerosis similar to that seen in the retina.

Discussion. Dr. M. H. BARKER said he had been interested in Dr. Wagener's work since the appearance of his early paper on the subject of retinopathy. His comment, that inspection of the eye does not give an indication of what may be expected in the general vascular tree, bears out the opinion of most clinicians. It is also true that there are lesions that tend to heal independently of the course of the disease, yet it would seem that clinically the damage to the eye grounds serves as an index and that it all marches on irregularly as part of the general picture.

Internists frequently see patients because of some episode that has occurred in the eye, where the disorder is first noted by the patient. It is only through the coöperation of ophthalmologists that an ultimate understanding will be reached. The experimental work of Goldblatt and others in renal ischemia has been of help. Experimental animals develop eye-ground changes, but "malignant" change occurs only about once in 12 animals. This brings to mind that the human being does not always develop malignant ocular disease. The pressure may be very high for a long time and subside without showing ocular breakdown. Possibly it is due to individual vascular vulnerability. Certainly in the animal there is no way of knowing which animal will develop this malignant eye change.

Recent experimental evidence is important as a possible explanation, notably that of Page and his co-workers. In their carefully controlled and intricate experiments they have purified and crystallized rennin. It has been shown that an enzymelike material is necessary to make rennin into an active vasoconstrictor substance, called angiotonin. Whenever the diastolic pressure to the kidney falls below 50 mm. rennin is poured out in large amounts, which is then activated by the "rennin activator" found only in the blood stream, with the compensatory elevation of the systolic blood pressure through vasoconstriction. These beautiful physiologic demonstrations will eventually lead to a solution of the problems with which the oculist and the internist have to deal. In the meantime careful study and continued observation should be stressed.

DR. LOUIS LEITER believed that it was stimulating to have any sort of classification of retinal vascular changes set up, especially when supported by such good evidence as Dr. Wagener had brought to his theory of angiospastic retinopathy. The conception that the acute retinal changes are much the same regardless of the etiology of the hypertension—whether the latter be due to acute nephritis, lead poisoning, preëclampsia, or other causes—is interesting. Without knowing the clinical features aside from the findings

in the eye grounds it would be hard to say what process is responsible. When considering the vascular sclerotic process as indicated by arteriovenous nicking, indentation, or whatever it may be called, the problem is different. But if the factor of old age is eliminated, one is always faced with hypertension, no matter how it is produced. Between the sclerotic processes and the angiospastic and exudative processes there is one difference—the period of time. It takes a long time for retinal sclerosis to develop in individuals with hypertension, even with a high diastolic pressure. That would explain why retinal arteriosclerosis was not found in the child eight years old with atrophic pyelonephritis. A period of seven or eight years of hypertension is not always long enough to produce retinal arteriosclerosis. The same is true in adults. Chronic pyelonephritis occurs so often that if the cases that are overlooked are taken into account, the chances are that there are more hypertensive ones with pyelonephritis than with glomerulonephritis, yet one does not ordinarily see sclerotic retinal changes in the former group, although one may see spastic lesions when the blood pressure is rapidly elevated at certain stages of the disease. In other words, in any form of hypertensive disease the retinal sclerosis depends on time as perhaps the chief factor, another being the degree of elevation of the blood pressure. Some patients go on for many years without evidence of retinal sclerosis. On the other hand, other individuals whose diastolic blood pressures may be 120 to 140 mm. may within five or six years develop obvious sclerotic changes.

It is not certain that in some individuals with the angiospastic form, a sclerotic change cannot also be shown. In most of the cases of malignant hypertension seen in the terminal stage the exudative changes give the impression that the disease has been existent for only a short time. Most patients have had it, however, for longer periods than was previously assumed. It is true that the malignant phase develops rapidly from the standpoint of duration of life after the onset of severe symptoms, but it is not true that is develops rapidly from the standpoint of hypertension as such; hypertension may have preceded other findings by many years.

Often it is impossible to obtain an accurate history of the duration of hypertension. An ophthalmologist may look at the eye grounds and see papilledema or hemorrhages and conclude that the patient has malignant hypertension. The internist may not even find significant change in the urine or renal function. After a few months there may or may not be renal signs. The retinal hemorrhages may clear up, edema may disappear, and the eye grounds become nearly normal, and the patient may go on for some time before he develops renal arteriosclerosis.

It is important to recognize that the retina is not merely a mirror of what goes on in the body, but also has its own local disease. In correlating retinal with other forms of vascular disease, we do not expect to find a similar change in different vessels of the body. In the retina there is the factor of intraocular pressure. Retinal arteriolosclerosis is quite unlike that in the heart. On the other hand, arteriolosclerosis is common in the spleen and kidneys; in the kidney only when associated with hypertension. Too much emphasis should not be placed on the changes in the vessels themselves.

Dr. Wagener's conception of a dynamic process is very important. The changes in retinal arterioles are those seen before the exudative process develops in the eye. In the kidney, in patients with hypertension, the arterioles almost always show fatty and hyaline

changes at autopsy. Are the arterioles leading to the glomeruli damaged primarily or are the changes secondary to the many years of hypertension? There has been a tendency to believe that the renal vascular changes are primary, but as autopsies are not obtained early in hypertension this question is not yet settled. Yet it is important, inasmuch as the theory of etiology is likely to furnish the foundation of treatment. If the renal arterioles are degenerated in the early fourth and fifth decade of life preceding hypertension, the outlook for treatment is rather hopeless. On the other hand, if the vascular process sets in only after years of hypertension, the therapeutic problem is much more hopeful.

In connection with angiospastic lesions, what is Dr. Wagener's experience with individuals who have emotional hypertension, in whom the blood pressure may rise considerably for short periods? Do such patients also show changes in the retina or is this neurogenic type different from what the ordinary chemical type is assumed to be? If hypertension has existed long enough to produce cardiac failure, why do some patients go on to complete failure without changes in the retina?

As Dr. Wagener pointed out, exudative lesions in the retina have a strong tendency to recovery even though the underlying disease continues. Improvement in the eye grounds is not a good criterion for judging the effect of therapy. Finally, what is Dr. Wagener's opinion with reference to surgical treatment of hypertension? What is his observation on the retinal vessels in patients who have been operated on, particularly in the group in whom blood pressure has not returned to normal although the patient may have been relieved of some of his symptoms?

Dr. Henry P. Wagener (in closing) thanked Dr. Barker and Dr. Leiter for the discussions, and said that both had raised questions of great importance to ophthalmologists as well as to internists. Retinal changes do not develop, as a rule, in persons in whom the blood pressure rises transiently as a result of nervous tension. The so-called central angiospastic retinopathy is supposed to develop where there is a tendency to general vasoneurosis. But lesions similar to those seen in hypertensive disease are not observed in such cases. The lesions seem rather to be related to the Raynaud or Buerger type of peripheral vessels than to hypertensive disease.

It is difficult to say why retinal changes are so minimal in many cases of hypertensive cardiac failure. It is possible that the lesions seen represent the residuals of a single angiospastic episode at the onset of hypertensive disease. These individuals may never have another angiospastic episode, and the retinal lesions do not increase, but as a result of residual organic damage in the systemic arterioles a chronic hypertension persists, with gradual development of cardiac hypertrophy and ultimate cardiac failure. There does not appear to be any direct relationship between the height of the blood pressure and the degree of chronic arteriolosclerotic change visible in the retina. In a certain group of cases there is a very distinct relationship between the duration of the hypertensive disease and the degree of visible arteriosclerosis. It is probable that, in many instances, the changes in the retinal arterioles progress, not slowly and steadily but by jumps as the result of a series of angiospastic episodes.

In the attempt to distinguish ophthalmoscopically between retinitis of malignant hypertension and a diffuse retinitis with edema of the discs, in a patient in whom the hypertensive disease does not

run a malignant course, the determination of the presence or absence of a chronic type of sclerosis in the retinal arterioles is of utmost importance. Just as in hypertensive toxemia of pregnancy, an acute angiospastic retinitis with edema of the optic discs may develop in the presence of previously normal arterioles, in a patient with acute vasospastic hypertension in which there is a tendency to recovery. On the other hand, when an acute angiospastic retinitis with edema of the discs develops in the presence of chronic sclerosis of the retinal arterioles, the hypertensive disease almost invariably runs a typical malignant course.

Following splanchnic sympathectomy for the relief of hypertension, retinitis has been observed to subside in a number of cases. This does not mean that the operation will result in permanent relief of the hypertensive disease, since there is a tendency for acute episodes of retinitis to subside even without treatment. Alteration in the condition of the retinal arterioles is more significant. In cases that do well after surgery it will be noted that the caliber of the retinal arterioles improves, in general, and that the localized spastic constrictions tend to disappear. No decrease in the degree of the chronic arteriosclerotic lesions has been observed even when the blood pressure is reduced to normal or practically so. In an individual with any considerable degree of chronic sclerosis in the retinal arterioles, it is rather rare for the blood pressure to remain permanently at normal levels after surgery.

It seems logical to assume that the lesions in the retina and its arterioles in hypertensive disease are produced by a circulating vasopressor substance. It does not seem necessary to assume, however, that this substance originates in the kidneys in every case. A retinitis simulating in every respect that of malignant hypertension may be seen in patients with hypertension secondary to cortical adenoma of the adrenals and to basophilic adenoma of the pituitary. There is hope, therefore, that all cases of hypertension are not due to primary sclerosis of the renal arterioles.

Robert von der Heydt.

COLORADO OPHTHALMOLOGICAL SOCIETY

January 20, 1940

Dr. Melville Black, *presiding*

Bilateral colobomata of irises

Dr. W. M. Bane presented B. J., aged 24 years, who came in for examination January 4, 1940. The vision with the right eye was 5/7 and with the left eye 5/10. The refractive error consisted of a moderate amount of hyperopia with astigmatism, the correction of which gave normal vision in each eye. The case was shown because of the colobomata which were present. The right eye has the typical complete inferior coloboma of the iris with no coloboma of the lens nor of the choroid. The left iris shows an unusual incomplete coloboma inferiorly with a bridge at the pupillary margin and a defect in the pigment layer from the pupillary margin to the lower periphery of the iris. This is accentuated by transillumination.

Free cyst in aqueous

Dr. V. H. Brobeck presented O. N., a white man aged 50 years. When first seen, in 1932, a hypermature cataract of the right eye was found. On March 10, 1932, a preliminary iridectomy was performed. On March 30, 1932, a lens extraction was attempted, but vitreous presented just as the knife made the counter puncture. The

incision was not completed and the operation was discontinued. On September 1, 1932, a very interesting phenomenon was noted. When the patient's head was thrown back a spherical opaque globule was observed to float down through the midpupillary area. On righting the head this globule retreated back behind the limbus in the region of the coloboma. This perfectly round globule measures about 2.5 mm. in diameter. It is entirely free and seems to be much lighter than the aqueous as it always assumes the least dependent part of the chamber. There has been practically no change in its appearance since first observed in 1932.

Dilated iris vessels associated with incipient cataract

Dr. Charles Walker, Jr., presented the case of Mr. J. H., aged 59 years, because of the peculiar appearance of the left iris. The left eye had been apparently normal until nine years ago. At that time frequent changes in lenses had become necessary and vision gradually became poor. At the present time the anterior surface of the iris is largely covered by many dilated vessels from between the 7- and 12-o'clock positions. Gonioscopic observation shows that the vessels extend to the root of the iris at the 9-o'clock position. There are incipient lens changes which prevent a clear view of the fundus, but it appears grossly normal. Transillumination is normal. The tension is not elevated. While there is some question of the existence of a neoplasm, it was considered best to observe the eye carefully.

Choroidal detachment

Dr. Leonard Swigert and Dr. Horace Weston presented the case of Mrs. M. C., aged 81 years, who had had an intracapsular cataract extraction performed on the right eye on November 10, 1939. The surgery and postoperative course were uneventful until two large detachments of the choroid were noted on the tenth postoperative day. The detachments were first superior and inferior. Later there was also some elevation on the lateral and medial walls. The disc and surrounding fundus can be clearly seen. The tension is approximately normal and there is no evidence of leakage from the wound. There has been a slight decrease in the size of the detachment during the past two weeks.

Discussion. Dr. M. Marcove stated that he had seen Dr. W. C. Finnoff successfully treat a similar case by aspirating the detached area with a hypodermic needle thrust through the sclera.

Dr. Melville Black suggested that no surgery be attempted until a long period of observation made it apparent that the detachment would not spontaneously recover.

Dilated pupils with retained intraocular steel

Dr. R. W. Danielson and Dr. J. C. Long reported three cases of delayed removal of an intraocular piece of steel in which the predominant and only definite sign of siderosis was a dilated pupil.

The first patient was a 39-year-old mechanic who had been struck in the left eye by a piece of steel on October 13, 1938. Soon after the injury he was examined and X-ray pictures were made by another physician, but apparently the picture demonstrated no steel. About two weeks after the injury, the patient noticed that his left pupil began to be much larger than the right. About this time he was having a recurrence of osteomyelitis. He first came for examination on May 23, 1939, complaining that for six weeks the eye had been inflamed. In the upper part of the cornea, one could see a scar and immediately behind that was a hole in the iris. The pupil was dilated and did

not react to light. The uncorrected vision was 20/40. With a small correction it was 20/20. The piece of steel was successfully removed on May 30, 1939. By December 22, 1939, the vision was still normal as corrected and the pupil had come back practically to normal size.

The second patient was a 29-year-old man who had been struck in the right eye by a piece of steel on April 13, 1939. X rays were taken at the time but did not show an intraocular piece of steel. The patient noticed on May 24th that the pupil of the right eye was dilated. He came to them on September 8, 1939, at which time a scar was found in the cornea, a hole in the iris, and a dilated pupil which did not react to light. Another X ray taken at this time showed a piece of steel within the vitreous, which was successfully removed on September 9, 1939. On December 22, 1939, the vision was 20/20 with correction. On January 28, 1940, the patient wrote to us that the pupil was now normal in size.

The third patient was a 27-year-old man who, on October 4, 1939, was struck in the right eye. About one month after the accident, he noticed that the pupil of the right eye was becoming larger. On examination with the slitlamp a tiny scar was found in the cornea and a small peripheral hole in the iris. The pupil was widely dilated. The X ray showed an intraocular piece of steel which was removed by the method of Sherman described in the American Journal of Ophthalmology (December, 1939, p. 1368), which, incidentally, the essayists recommend highly. On December 29, 1939, the vision with correction was 20/30. The patient wrote to them on February 6, 1940, that his pupil was now almost back to normal size.

Conclusions from these cases would therefore be: (1) X-ray pictures, unless taken by experts, may give one a false sense of security in dealing with intraocular foreign bodies. (2) Often, the first symptom noticed by the patient subsequent to the injury is a dilated pupil. (3) Prognosis for the pupil returning to normal would, from our series of cases, seem to be good.

ORTHOPTICS

DR. JOHN H. JUDD, of Omaha, by invitation, presented the address of the evening on this subject.

JOHN C. LONG,
Recorder.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

January 16, 1940

DR. J. HERBERT WAITE, *presiding*

THE TOXIC AMBLYOPIAS

DR. FRANK D. CARROLL of New York City said that toxic amblyopia is a partial or complete blindness caused by some toxic agent which interferes with the function of the retina, optic nerve, or more central optic pathway. Every new drug used in medicine and every new chemical used in industry is a possible cause of toxic amblyopia so that this subject is constantly increasing in scope. It is very important to recognize this condition because the prognosis is frequently good if the etiology is determined and unfavorable if not discovered. Patients are becoming more and more compensation minded and the ophthalmologist, in order to be fair to both employer and employee, must have a thorough knowledge of this subject.

The toxic amblyopias may be divided into three groups: (1) poisons which produce cortical or central blindness, (2) those depressing the entire visual field but more especially the peripheral fields,

and (3) those depressing exclusively or chiefly the central visual field.

In cortical blindness there is a complete or almost complete loss of vision, but the pupils react to light because the lesion is above the light center. Causes of this are: (1) Uremia. (2) Carbon monoxide—this may be obtained from illuminating gas, fumes from autos, mines, furnaces, and sewers; acute carbon-monoxide poisoning as a cause of toxic amblyopia is a definite entity, but whether chronic carbon-monoxide poisoning ever causes optic-nerve damage is very questionable. (3) Postanesthesia—infrequently optic-nerve injury may result during anesthesia, probably due to anoxemia. (4) Acute alcoholic amaurosis—complete blindness in a person whose pupils react normally to light and who has acute alcoholism suggests this diagnosis; hysteria must be excluded, edema of the cortical cells is probably present. The prognosis is excellent and the patient is usually well in 24 hours. It is important to differentiate this from methyl-alcohol amblyopia.

Conditions and poisons depressing the entire visual field but more especially the peripheral field include: (1) Arsenic—tryparsamide and atoxyl. There is a considerable difference of opinion by leading authorities as to whether or not tryparsamide should be used when the optic nerve is diseased. In the opinion of some it may be used under close supervision even when optic-nerve atrophy is present. Others believe that if there are any field changes the drug should be immediately stopped. Subjective symptoms are an important warning sign. Visual fields should be taken before the first, third, fifth, and tenth injections, and before every tenth injection thereafter as a reasonable precaution. Most reactions occur within the first 10 injections. Forced spinal-fluid drainage may be used in acute tryparsamide intoxication. Neo-arsphenamine. (2) Antimony, used in leishmaniasis. (3) Barbiturates—these usually are a cause only when used in very large doses; treatment with picrotoxin. (4) Benzol (benzene), used by makers of artificial leather, by rubber cementers, dry cleaners, engravers, lacquer makers, paint makers, vulcanizers. Also dinitrobenzol. (5) Blood loss—this occurs in patients whose general health is below par, whose red-blood-cell count and hemoglobin are markedly reduced; treatment with transfusions is advisable. (6) Burns—toxemia may produce encephalopathy, retinal hemorrhages, and amblyopia. (7) Carbolic acid—report of a case following its use in a 3-percent solution in the pleural cavity. (8) Carbon tetrachloride—used for cleaning purposes and also as an anthelmintic. (9) Felix mass—used as an anthelmintic; the prognosis is poor. (10) Gelsemium. (11) Methyl-alcohol, (a) danger from inhalation as illustrated by painters who develop optic-nerve atrophy working in closed spaces where there are wood-alcohol fumes, (b) cases of optic-nerve atrophy in patients who have used wood alcohol in lamps, danger from external application—optic-nerve atrophy developing in children who have been sponged with methyl alcohol. Taken by mouth it usually produces abdominal pain, vomiting, and poor vision. Recovery is often followed by relapse. Lumbar puncture and alkalies by mouth may be of value. (12) Optochin—produces a picture like quinine poisoning; the prognosis is worse. (13) Quinine—in very small doses may produce amblyopia in patients with idiosyncrasy. The fundus usually shows edema of the retina, contraction of vessels, and later optic-nerve atrophy; there may be complete loss of vision, often very rapid in the early stage. This improves, but permanent contraction of fields with

good central vision is a common end result. Plasmocine and quinidine may also produce toxic amblyopia. (14) Salicylates may produce a picture similar to quinine. The prognosis is better.

Miscellaneous causes of optic neuritis include: (1) Allergy—reports were made of optic neuritis due to sensitivity to chocolate, pork, horse serum, milk, and fish. (2) Beriberi—amblyopia resembles tobacco-alcohol amblyopia. (3) Diabetes—a report was made of a single patient who did not smoke nor drink; a cure was obtained after use of vitamin B. (4) Digitalis—produces sensation of colors, red, blue, green, yellow, white; flashes of light, sparks, flickering. (5) Santonin—produces xanthopsia; other causes of xanthopsia are amyl nitrite, picric acid, chromic acid. (6) Hasheesh or marihuana—may produce violet vision.

Poisons depressing exclusively or chiefly the central visual field are: (1) Carbon disulphide—this is used widely in the rayon industry, also in the preparation of rubber, explosives, hides, insecticides, and wool. It is usually accompanied by polyneuritis and other evidences of toxemia. (2) Iodoform—used on wounds or internally. (3) Lead—found in compositors, painters, plumbers, storage-battery makers, and children who eat paint off cribs.

Normals for lead and arsenic:

Lead

Blood—0.02-0.08 mg. per 100 gm.
Urine—0.02-0.08 mg. per 24 hours.
Feces—0.25-0.38 mg. per daily output.
Spinal fluid—.05 mg. per 100 c.c.

Arsenic

Blood—0.03-0.06 mg. per 100 c.c.
Urine—0.03-0.06 mg. per 24 hours.
Spinal fluid—.03 mg. per 100 c.c.

(4) Snuff—usually due to the tobacco in the snuff, but formerly some snuff had lead in it to increase its weight and lead poisoning has been reported in snuff users. (5) Sulfanilamide—a single case was reported with central scotomas and contracted fields which rapidly improved when the drug was stopped. (6) Spinal anesthesia—several cases of paralysis of the sixth nerve have been seen and in one of these there was retrobulbar neuritis (7) Stramonium—acute poisoning causes cycloplegia; chronic poisoning produces bilateral centro-caecal scotomas. It is used in cigarettes by asthmatic patients because its relaxes the bronchiolar muscles. (8) Thallium—this is used as a depilatory and most of the reported cases have been of women with excessive hair growth; it is also used in industry and is a rat poison; peripheral neuritis usually precedes visual disturbance. (9) Tobacco-alcohol—this is the most common and most important toxic amblyopia seen in this country. It comes on gradually and occurs in an age group which may show some senile changes in the eye. It is important to differentiate this from senile macular degeneration because the prognosis is good in tobacco-alcohol amblyopia and poor in senile macular degeneration. Recent research has shown that it is possible for patients with this condition to continue smoking and drinking and to recover completely provided they take an adequate amount of vitamin B.

Discussion. Dr. Garrett L. Sullivan of Boston presented three cases of toxic amblyopia. The first one presented was of a 31-year-old male printer who entered the hospital last year complaining of rapidly failing vision in the right eye for one week; failing vision in the left eye for the past two weeks. No pain nor redness was associated with it. The patient gave a history of drinking about eight glasses of ale a night, about three times a week, for the past two years. He smoked one or two packages of cigarettes a day. He was referred to the hospital by his medical doctor who had made a

routine inquiry as to his diet and intake of essential vitamins, and he felt it was adequate. The Wassermann test was negative. The vision in the right eye was 20/200 and in the left eye 6/200. Examination of both eyes, internally and externally, was negative. The visual fields, however, were of interest. The field showed restriction inferiorly in the right eye and nasally in the left eye. The central field showed a small scotoma with 1/2,000 test object. Also in the centro-caecal area were two small definite scotomata. The left eye showed typical centro-caecal scotoma with 2-mm. test object. The patient was unable to see a 45-mm. red or green test object anywhere in the field. Placed on brewer's yeast and advised to omit alcohol and tobacco the patient's vision improved to 20/70 in the right eye and 20/100 in the left eye, in one week. Neurologic examination was negative. Two months later the vision in the right eye was 20/20 and in the left eye 20/20-2. There was moderate gain in weight, and he began to smoke cigarettes again but denied taking alcohol except for an occasional ale. Four months later the vision in the right eye was 20/50 and in the left eye 20/70 and he admitted that at a New Year celebration he had taken alcohol. However, two weeks later his vision was again 20/20 in both eyes. Peripheral and central fields were normal. He has been taking alcohol, in the form of ale, since.

The second patient presented by Dr. Sullivan was a 56-year-old W.P.A. worker who entered the hospital complaining of failing vision of two weeks' duration. The vision was 20/200 in the right eye and 10/200 in the left eye. External examination of the eyes was negative for pathology, as were also the fundi. The patient used considerable alcohol and tobacco. Typical centro-caecal scotomata, with lack of disproportion between colors and white test objects, were found. Scotoma was present for 26/1,000 white test objects. This size red and blue target was seen in the periphery. The patient was advised to stop the use of all alcohol and tobacco and placed on brewer's yeast. In three weeks there was marked improvement despite the density of the scotoma when seen originally. The vision was 20/70 in the right eye and 20/50 in the left eye. The paracentral scotoma was still dense.

The last patient presented was a 73-year-old man who entered the hospital complaining of rapidly failing vision of one month's duration, with a history of constant use of tobacco and alcohol (whiskey). His vision was 8/200 in the right eye and 18/200 in the left eye. The examination was negative except for slight difference in the reaction of the pupils—the left reacted more promptly than the right. Perimeter fields were quite full and normal. He stated his appetite was poor and that he had been living on tobacco and alcohol and coffee and doughnuts. He showed a typical centro-caecal scotoma in the right eye. The patient was given yeast tablets and cod-liver oil and advised against using tobacco and alcohol. One month later his condition was unchanged. Two months later there was still no change. He continued this way with an indefinite history of tobacco and alcohol intake. Four to five months after entry the right eye showed pallor of the disc. Six months later the vision had improved slightly to 20/100 in the right eye and 20/70 in the left eye. Peripheral fields were still normal. Three months after this the patient returned and stated that he was able to read the newspaper. The vision in the right eye was 20/70 and in the left eye 20/50; both eyes together 20/40. Dr. Sullivan was quite certain that this patient never completely stopped the use of tobacco and alcohol.

Virgil G. Casten,
Recorder.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

SECTION ON OPHTHALMOLOGY

January 18, 1940

DR. FRANCIS HEED ADLER, *chairman*

CORNEAL ULCER ASSOCIATED WITH LYMPHOGRANULOMA VENEREUM

DR. GEORGE P. MEYER and DR. JACOB REBER presented a case of corneal ulcer because of its rare association with lymphogranuloma venereum. It will be reported in full in this Journal.

Discussion. Dr. Robert J. Hunter said he was very much interested in hearing of the case of lymphopathia venereum, because of a case at the Philadelphia General Hospital which Dr. Cowan and Dr. E. J. Donnelly studied along with him. Apparently that diagnosis was made at a time before they knew so much about virus diseases. The case was one in which there was a marked keratitis of both eyes. The patient came in with very acute symptoms, and their first thought was of acute sinusitis. After taking the case history, going into the venereal history, and making the extensive studies possible at a large institution, they finally arrived at the conclusion that it was lymphopathia venereum. The Frei test was not fully accepted by the profession at that time. Dr. Nesselrode was especially interested in the Frei test, so they used the antigen that he and Dr. Collier Martin had prepared, and in each instance the test was positive. Before they arrived at the conclusion that this was a case of lymphopathia venereum they considered many other diseases, especially onchocerciasis.

Since they made their diagnosis, sulfanilamide has been discovered and they have given their patient some. The swelling is as marked as ever, but the patient is improved.

DISEASES OF THE EYE PRODUCED BY VIRUSES

DR. PHILLIPS THYGESON presented a paper on this subject.

Discussion. Dr. Baldwin Lucke hoped it was not presumptuous to emphasize one point Dr. Thygeson made; namely, the initial stimulating effect of viruses upon cells. So far as he knew, all viruses cause some proliferation of the cells which they inhabit. This multiplication may not proceed far, but even in smallpox and similar destructive lesions the initial effect of the virus is cell multiplication. Cell destruction without initial multiplication occurs only in cells that do not possess the capacity for multiplication in postfetal life (for example, brain cells). One can construct a graded series of proliferative lesions from the temporary cell multiplication such as occurs in herpes and the poxes to a more lasting proliferation such as occurs in molluscum contagiosum or in myxomatosis of rabbits, to permanent progressive neoplasms, such as chicken sarcoma, Shope's rabbit papilloma, and frog adenocarcinoma.

He has studied the growth characteristics of frog carcinoma by implanting it into the anterior chamber of the eye. In such transplants three patterns were observed. Unimpeded outgrowths into the aqueous humor characteristically assumed a tubulo-papillary arrangement. The earliest formation consisted of solid, purely epithelial cylinders, many of which at later stages acquired a lumen and thus became tubular; generally only the coarser projections developed vascular stalks. Where the tumor grew in contact with firm, even surfaces, such as lens or cornea, differentiation was lost and broad membranes formed that gradually spread over the surfaces; secondarily, new cylindrical or tubular processes arose from such indifferent cellular carpets. Where the tumor made contact with loose tissue

such as iris, it invaded this organ, and, supported by the stroma, assumed an acinar pattern quite like that of the original adenocarcinoma of the kidney. The present experiments support the view that cancers are much more responsive to the laws governing growth and organization than is generally supposed.

Dr. Thygeson said in closing that lymphogranuloma inguinale (lymphopathia venereum) may prove of increasing importance in ophthalmology in view of the number of positive Frei tests being obtained in patients with various ocular disorders. At the present time, however, it is necessary to demonstrate the virus in the lesion before one can establish the etiology conclusively. Eventually, as the type or types of eye lesions that can be produced by the virus become known through animal experimentation and clinical observations, it may be possible to diagnose the disease on clinical findings alone.

WARREN S. REESE,
Clerk.

AMERICAN JOURNAL OF OPHTHALMOLOGY

Published Monthly by the Ophthalmic Publishing Company

OPTICS IN THE MIDDLE AGES

Theory replaces or modifies theory. We are still somewhat insecure in our understanding of the nature of light. The frequent instability of scientific theory is nicely illustrated in Pope's oft-quoted couplet which now sounds rather ironical than heroic:

"Nature, and Nature's laws, lay veiled in night.
God said, 'Let Newton be,' and all was light."

A more recent poet, Squire, humorously supplemented Pope's epigram as follows:

"It could not last, the devil, howling 'Ho!
Let Einstein be,' restored the status quo."

In 1669 Newton, an intellectual giant, initiated his studies in the field of optics, the outcome being a theory of light which was almost universally accepted for the next century and a half. According to this theory visual sensations are produced "by the impact upon the retina of minute corpuscles emitted from luminous bodies which pass freely through transparent substances, differences of color being due to different size in these small bodies." This so-called "corpuscular" theory failed to satisfy such common phenomena as partial reflection from the surface of a transparent body, and the peculiar effect known as diffraction.

In 1678 the Dutch philosopher Huyghens, whose greatness was only eclipsed by that of the greater Newton, published a paper in which he explained the phe-

nomena of light as depending upon the movement of waves in a medium pervading all of space and which he called the luminiferous ether. Huyghens's reasoning and experiments were simple and conclusive, but Newton's doctrine controlled the scientific field until in the first third of the nineteenth century a young French engineer, Augustin Fresnel, demonstrated that all the known phenomena of light could be much more satisfactorily explained upon the basis which Huyghens had propounded almost 150 years earlier.

The mechanical interpretation of light gave way, at the hands of Clarke Maxwell, to the electromagnetic explanation. In the past thirty years the new conception of matter as an electrical manifestation, based upon protons and electrons, has again modified the undulatory theory of light. Some writers proclaim that the "luminiferous ether" is a myth, while others apparently are disposed to maintain that some such mysterious vehicle is a necessary basis for the explanation of light and other phenomena.

The study of the history of science is not a utilitarian pursuit. It belongs rather to the intellectual recreations of modern man. In some small degree it gratifies our natural curiosity concerning the hidden past, although we are apt to smile at the artificial and seemingly childish character of much that we read.

The Arab civilizations played an important part in rendering available, during the so-called "revival of learning" of the Middle Ages, a number of speculative writings of ancient Greece. During the twelfth century, as pointed out by Ten Doesschate (Ophthalmologica, 1940, volume 99, page 333), many of the books translated from the Arabic into Latin consisted very largely of translations and compilations from classical Greek manuscripts.

But these Latin translations stimulated the enthusiasm of western scholars for the pursuit of natural science, and the thirteenth century was a period of feverish activity in the study of natural phenomena and in the writing of new literature which was a mixture of ancient and medieval thinking.

In the field of optics the leaders were Roger Bacon, the English monk, whose Opus Majus appeared in the year 1267 of the Christian era, and John Peckham, Bishop of Canterbury (1235 to 1292).

Roger Bacon held in great respect one Robert Grosseteste, an older contemporary and friend from whom perhaps Bacon had gained much inspiration in his own earlier days. Grosseteste was born probably in 1175, thirty-nine years before Bacon, and Doesschate believes that Grosseteste delivered some lectures on optics which Bacon mentions as having been given at the University of Oxford. The older man was elected Bishop of Lincoln, and long after his death he continued to exert a great influence upon English thought and literature.

Under the title of "Perspective" (De Perspectiva) Grosseteste wrote concerning a branch of mathematics corresponding to what we now call geometrical optics. Two ancient theories concerning the nature of sight are referred to as follows: "Therefore natural philosophers, when treating the natural and passive part of 'seeing,' assert that we see by inward reception. But the mathematicians and the physicists, considering that which is beyond nature, when treating the preternatural and active part of vision, assert that we see by means of emanation."

Of this same conception of the act of seeing as depending upon an emanation, the Greek Aristotle, in his "book" on animals, about eighteen hundred years earlier, had written as follows: "A deep-set eye is long-sighted; for its motion is not dissipated, nor is it consumed, but from such an eye visual power takes its origin and it goes right to the visible objects."

Aristotle also said, in the same work: "The three mentioned senses, viz. seeing, hearing and smelling, emanate from the sense organs like water runs out of tubes, and therefore rather long noses allow good smelling."

The rays of sight were described as reaching the visible object in three ways: "A straight way through a homogeneous transparent body between the eye and the object, or by reflection from a mirror, or refracted by passage through bodies of different transparency (being then in an angular fashion at the plane of contact of these bodies)."

In Grosseteste's teachings concerning optics there was nothing original. His division of optics into three parts followed the lines laid down several centuries before Christ by the Greco-Egyptian mathematician Euclid and several centuries later by the astronomer and mathematician Ptolemy. But there is reason to accept Grosseteste's assurance that before him no one in England had treated the subject of the refraction of light. He was one of the few western scholars of that period genuinely interested in natural laws, optics, and mathematics; and, like many teachers, he contributed to the intellectual development of others whose reputation is much greater than his own, namely Roger Bacon and John Peckham.

Doesschate believes that Grosseteste was the earliest western writer to suggest the possibility of constructing magnifying glasses. Grosseteste had said: "This part of optics, when perfectly known, will show how to make objects situated at a great distance appear very near to us . . . and how small objects at a great distance may appear as big as we wish, so that we may be able to read very small characters at an incredible distance. . . ." Then he cited the very familiar experiment in which an object concealed within an open vessel is rendered visible by filling the vessel with water. This phenomenon, however, had been described by Ptolemy in the second century, and had been mentioned repeatedly by later writers.

Grosseteste and others were ignorant of the principle involved in what we now call the index of refraction, and they went badly astray by assuming a false geometric analogy between refraction and reflection.

Living in an age when most scholars were steeped in metaphysical concepts and believed that knowledge was to be attained by simple deduction, it is not surprising that Grosseteste, and many other teachers of the Middle Ages, wrote a great deal that to us appears childish and curiously inadequate. Yet these scholars of the thirteenth century played a significant part in carrying onward the torch of learning.

We may derive an intellectual satisfaction from the sense of continuity with the past. It is possible that modern education, with its utilitarian outlook, tends to break too rapidly with this spirit of continuity in human experience and knowledge. Time and labor, with now and then an element of accident or chance, are necessary factors in human progress. With no greater intelligence, perhaps, our descendants will know vastly more than we now know, and facts and principles which now lie on the dim horizon of the erudite will be the common property of future generations. W. H. Crisp.

SULFANILAMIDE COMPOUNDS IN OPHTHALMOLOGY

Ever since Domagk's initial paper on Prontosil, which appeared in the Deutsche medizinische Wochenschrift (1935, v. 61, p. 250), articles by contributors throughout the world reporting their investigations of the therapeutic action as well as possible deleterious effects of chemotherapy with the sulfur compounds are to be found in nearly every

issue of almost any medical journal. New methods and indications for use of the various drugs are appearing with every turn of the wheel.

A pertinent handbook or monograph on chemotherapy needs revision almost at the moment of its appearance in the light of facts daily appearing. To maintain up-to-the-minute and comprehensive information would require a sort of loose-leaf system supplied by teletype from an appropriate center.

Properly to evaluate a new therapeutic agent requires slow but fine grinding. Much time, patience, and control must be exercised in the conduction of the experiments. Many repeated clinical observations must be made by trustworthy, competent clinicians, and filed, tabulated, and reported. The reports must be gathered, sifted, and either verified or not by other investigators. Only in this way can our sure knowledge grow. It is one of the glories of modern medicine that so many such scientifically controlled studies on sulfanilamide and its derivatives have appeared in our literature.

It is unnecessary to mention the widespread interest and enthusiasm with which ophthalmologists have followed the thrilling story of the "wonder drug." Encouraging reports of its use in ophthalmic diseases continue to pour in. By this time all are familiar with its value in the treatment of trachoma, gonorrheal ophthalmia, orbital cellulitis, and corneal ulceration, including herpes. Many are aware, too, that now the honeymoon is over, it would be well to come down to earth. This wholesome attitude is exemplified by the article by Smith, Julianelle, and Gamet on "Sulfonamide therapy of trachoma," which appeared in the February number of this Journal. In it the authors expressed the opinion that in spite of the improvement, "recovery" from trachoma is not the rule but the exception. Furthermore, in their opinion, sulfonamide treatment should be supplemented by one of the more usual forms of local therapy. The same opinion had already been uttered by Lian and reiterated by W. L. Cooper in his article on "Management of recurrent trachoma following sulphanilamide therapy" (Arch. of Ophth., 1940, v. 24, p. 467). A note of warning is sounded not to forget the more valuable of the older therapeutic agents.

If the pneumococcus can become *sulfapyridine-fast* if inadequately treated, as reported by C. M. MacLeod (Jour. Amer. Med. Assoc., 1939, v. 113, p. 1405), it is possible that other organisms will likewise react in the same way. L. H. Schmidt, C. E. Claugus, and E. Starks (Proc. Soc. Exp. Biology and Med., 1940, v. 45, p. 256) have conclusively shown that *sulfapyridine-fast* pneumococci are equally *fast* to sulfathiazole and sulfamethylthiazole, and the authors suggest "the futility of attempting therapy with a second of these compounds when the pneumococcal infection becomes resistant to treatment with any one of these drugs." There is, then, some risk of rendering an organism *fast* if adequate treatment is not pursued. Whether this applies to other organisms than the pneumococcus remains to be seen.

As time goes on, more is being learned about the toxic effects of these drugs. E. A. Rittenhouse mentioned many of these effects when he reported a case of transient myopia after the use of sulfanilamide (Arch. of Ophth., 1940, v. 24, p. 1139). In the section of Medical Preparedness in the Journal of the American Medical Association (1941, v. 116, p. 513), is published a circular letter from a committee appointed by the National Research Council. It contains, among other valuable facts on chemotherapy, an interesting table on the various manifestations of toxicity due to sulfanilamide and its derivatives. The article repays

careful attention. P. H. Long and other associates of the biological division of the Department of Medicine of Johns Hopkins have recently prepared a table (Mississippi Doctor, 1940, v. 17, p. 541), giving a comparative clinical evaluation of these drugs, that tells at a glance what derivative to use. In addition they conclude that fear of toxic manifestations following sulfonamide compounds is, in general, unwarranted if a few precautions are followed. If the ophthalmologist is to use these drugs he must know the precautions.

Elsewhere in this issue of the Journal will be found three more articles on sulfanilamide *et al.* That of D. P. Hornbogen adds another case of transient myopia to the growing list of this complication and should be of interest on that account.

The other two deal with the perplexing and as yet unsolved problem of the local use of sulfanilamide compounds in the eye. J. S. Guyton's paper summarizes the literature and reports on experimental and clinical observations. His conclusions are honestly conservative and do not help us in one way or the other, although they are hopefully suggestive. A paper presented by Woods and Guyton before the Pan-American Congress in October, 1940, carries on further and more encouraging studies along this line. It will appear in an early issue of the Journal.

The exciting article by P. Panneton describes the dramatic improvement following the use of sulfanilamide powder insufflated into the conjunctival sacs of patients with ophthalmia neonatorum presumably gonorrheal. It is interesting to note that he found the powder to be nonirritating except for a relatively short period. This is at variance with the experience of J. G. Bellows and H. Chinn, who reported a moderate reaction causing chemosis and staining of the corneal epithelium of dogs after sulfanilamide powder was dusted into the conjunctival sac (Jour. Amer. Med. Assoc., 1939, v. 112, p. 2023). Incidentally, this important article on the "Distribution of sulfanilamide in the eye" may not have attracted the attention it warrants by ophthalmologists. Panneton placed sulfanilamide powder into his own conjunctival sac, however. V. Rambo (Abstract Amer. Jour. Ophth., 1941, v. 24, p. 90) applies the powder to the eyes every two hours during the day, thereby suggesting that it could not be intolerable.

Mengel (Arch of Ophth., 1939, v. 22, p. 406) found that "the amount of sulfanilamide absorbed into the aqueous from the conjunctival sac, when a concentrated aqueous solution (0.8 percent) was instilled, was less than 0.1 mg. per hundred cubic centimeters, whereas sulfanilamide was found in the aqueous and vitreous in a concentration 1.5 to 3.2 mg. per hundred cubic centimeters after administration by mouth." He calculated that "to obtain a dose by instillation in the eye equivalent to a single dose of 15 grains by mouth it would be necessary to have approximately 4⅙ ounces of a concentrated solution of the drug available in the conjunctival cul-de-sac long enough for absorption." This, of course, suggests that the saturated solution of sulfanilamide is too feeble and would necessitate almost continuous irrigations of the conjunctival sac to become as effective as if the drug were given by mouth.

The local use of sulfanilamide ointment or powder, in external ocular conditions particularly, is worthy of further trials and studies, and is of much promise.

Derrick Vail.

BOOK NOTICE

THIRTEENTH ANNUAL REPORT OF THE MEMORIAL OPHTHALMIC LABORATORY, Giza, Cairo, 1938. Paperbound, 137 pages, 35 black-and-white illustrations, 4 colored

plates. Printed by Schindler's Press, Cairo, Egypt, 1940. Price P.T. 35 (approximately $1.75).

This volume follows the format of its predecessors and is on a par with them in every respect. There are four beautiful color plates and many black-and-white illustrations. Numerous well-illustrated case reports are presented. Among the most interesting is one of lipoid degeneration of the conjunctiva and cornea.

Research has been devoted principally to the continuation of the studies of trachoma and a very full report of ophthalmomyiasis. Attempts to grow the virus of trachoma failed as they have elsewhere.

Treatment of trachoma with sulfanilamide compounds was reported more encouragingly than in the previous volume where only conjunctival cases were presented. These did no better, but those with corneal complications are reported as greatly improved. This improvement corresponds directly with the activity of the corneal lesion. No cases had to be discontinued because of toxicity. Of the 18 cases, though they are not listed individually, one gathers that all were benefited. The following statement is made: "In the course of a day or two the patient notices an obvious improvement and there is always a rapid advance towards cure, so much so that in many cases corneal infiltrations have resolved and subjective symptoms have almost entirely disappeared even after 10 days' or a fortnight's treatment."

In vernal catarrh no benefit from sulfanilamide compounds was obtained, nor was there any in Koch-Weeks infections, but good improvement was found in gonorrheal ophthalmia.

Almost no reference is made to the war, but surely great credit is due to those concerned for producing this excellent report during war days.

Lawrence T. Post.

ANGIOSCOTOMA DUE TO BRUCELLOSIS

The *attention of all ophthalmologists* is called to the following statement:

At the 1940 meeting of the New York State Medical Society, Dr. Jones and Dr. Norris of Rochester, New York, reported the finding of angioscotomata with reduced visual acuity in some instances, due to Brucellosis. The disease was diagnosed merely by the skin test. If these findings can be corroborated, it will become necessary to elaborate upon the already exhaustive ophthalmic examination of air pilots. But before advocating that step, further knowledge of the possible connection between the ophthalmic condition and the generalized infection must be studied.

The Subcommittee on Ophthalmology appointed by the National Research Council hereby requests all ophthalmologists to make an exhaustive examination of all suspected cases; that is to say, individuals with a reduced visual acuity that cannot be explained, with difficulties in dark adaptation, or with subjective indications of disturbances in the central visual fields. If the skin test for Brucellosis is positive and if definite angioscotomata are found, it is requested that an internist investigate the possible systemic infection.

Complete reports should be sent to Dr. Derrick Vail, 837 Carew Tower, Cincinnati, Ohio. Incomplete examinations or cases in which a reasonable doubt as to Brucellosis exists, should not be reported.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP
ASSISTED BY DR. GEORGE A. FILMER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

9

CRYSTALLINE LENS

Trantas, A., and Trantas, N. **Extraction of a cataract dislocated into the anterior chamber with glaucoma.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 293.

After making a small corneal section, a spoon was slipped behind the lens in the anterior chamber. The assistant then enlarged the section, and the cataract was removed in capsule without loss of vitreous. George A. Filmer.

Tumantzeva, H. F. **The use of the stenopeic slit in incipient cataract.** Viestnik Opht., 1940, v. 16, pt. 6, p. 492.

Tumantzeva calls attention to the usefulness of the stenopeic slit in improving near visual acuity and reading ability in cases of incipient cataract. If the slit is made long enough for one line of a printed page, it emphasizes the contrast and facilitates reading.

Ray K. Daily.

Yanes, T. R. **The techniques of suction in cataract.** Boletin del Colegio Medico de Camaguey, 1940, v. 3, July-Sept.

All syringe apparatus possesses an important inconvenience, namely lack of reserve vacuum. This lack makes it necessary to recharge the syringe when the suction is lost, no matter whether the syringe has a capacity of 20 c.c. or of 500 c.c.

When the suction cup has been applied, the extraction should not be hurried, but one should wait a little while, for the slight vibration of the cup sometimes succeeds in detaching the lens from the hyaloid. If necessary one makes use of intentional movements of the suction cup.

The author prefers Barraquer's original technique as modified by Green, tumbling the lens 180 degrees.

W. H. Crisp.

Zarembo, A. **Diffusion of dyes in the lens.** Viestnik Opht., 1940, v. 16, pt. 6, p. 450.

The objective of this study was to determine whether there is any difference in the physicochemical structure

of the anterior and posterior lens cortices. Isolated ox lenses, some in intact capsule and others with half of the anterior and posterior capsules removed, were suspended in solutions of various dyes, and the rapidity of diffusion recorded. A difference was indicated in the diffusion rate of neutral and acid dyes, and of crystalloids and colloids. In most cases there was a difference in the diffusion of the dyes through the anterior and posterior surfaces; this difference manifested itself also in the lenses from which the capsules had been removed. The author interprets the phenomenon as indicative of a difference in the physicochemical structure of the anterior and posterior lens cortices.

Ray K. Daily.

10

RETINA AND VITREOUS

Agnello, Francesco. **Retinal lesions from indirect trauma.** Riv. Oto-Neuro-Oft., 1939, v. 16, Nov.-Dec., pp. 459-474.

A man of 28 years noted marked reduction in vision following a head trauma. Many weeks later between the two temporal veins a round spot of grayish discoloration was discovered in which traces of old hemorrhages in the process of absorption could be seen. Following a head trauma, a woman showed two preretinal hemorrhages along the course of the temporal veins. The writer believes that in each of these cases the violent increase of intracranial pressure provoked sudden stasis in the central vein with consecutive rupture of its temporal branches.

M. Lombardo.

Steele, E. J. P. **Effect of vitamin-A therapy estimated by a rapid optical test.** The Lancet, 1940, v. 239, Aug. 17, pp. 205-206.

Steele describes a rapid visual test for vitamin-A deficiency in which the recovery time is measured by noting in seconds the interval between the cessation of light adaptation and the detection of a fixed target of low illumination. A series of 24 women, all in the last three months of pregnancy and with a history of long-standing vitamin-A deficiency, were treated with vitamin A and their light adaptation measured regularly. It was found that the treatment produced definite improvement in the group as a whole, although some did not respond. Vitamin D did not appear to increase the effectiveness of vitamin A.

T. E. Sanders.

Steffens, L. F., and Bair, H. L. **Dark adaptation and dietary deficiency in vitamin A.** Amer. Jour. Ophth., 1940, v. 23, Dec., pp. 1325-1339.

Stromberg, Günter. **An early form of Leber's degeneration of the retina with multiple aneurysms.** Klin. M. f. Augenh., 1940, v. 105, July, p. 103.

A man of 35 years showed changes of the smaller arteries of the retina, probably aneurysms in different stages, and partly appearing as glistening formations like mother-of-pearl. This was considered as an early form of Leber's degeneration of the retina.

C. Zimmermann.

Velhagen, K. T. **Hereditary transmission of retinitis pigmentosa.** Klin. M. f. Augenh., 1940, v. 105, July, p. 101.

Velhagen describes retinitis pigmentosa in a mother of 37 years with defective hearing from an internal ear affection. Her son aged 15 years was in an institute for the blind. His vision

was limited to counting fingers at 2 meters, and he showed contraction of the visual fields. C. Zimmermann.

Verhoeff, F. H., and Simpson, G. V. **Tubercle within central retinal vein: hemorrhagic glaucoma; retinal periphlebitis in other eye.** Arch. of Ophth., 1940, v. 24, Oct., pp. 645-655.

In a man aged 31 years, hemorrhagic glaucoma resulted in enucleation. Microscopic examination showed a tubercle obstructing the lumen of the central vein. The other eye had previously been affected with retinal periphlebitis. This finding strongly supports the view that retinal periphlebitis is tuberculous in nature. This case and a similar one previously reported, considered in connection with certain clinical cases reported in the literature, indicate that partial or complete tuberculous obstruction of the central vein is a frequent cause of suddenly occurring extensive retinal hemorrhages in young persons. When obstruction of the vein is so caused, more or less complete restoration of vision may occur. (Photomicrographs, discussion.) J. Hewitt Judd.

Wagener, H. P. **The significance of spasm in retinal arteriolar disease and in retinitis.** Trans. Pacific Coast Oto-Ophth. Soc., 1939, 27th mtg., pp. 165-177.

Wagener reports three cases in which acute occlusion of the retinal arteries followed transient attacks of blindness. He concludes that there is probably a local lesion in the vascular wall prior to the spasm rather than that angiospasm occurs primarily in the normal vessel. The reason for a localized angiospasm is still in the realm of speculation. Recurrent retinal-vessel spasms are definitely followed by pathologic changes in the tissues and permanent field changes. Lawrence G. Dunlap.

Wendling, Meinhard. **Retinal periphlebitis and tuberculous etiology.** Graefe's Arch., 1939, v. 141, pts. 2 and 3, pp. 198-213.

After a discussion of the scientific literature concerning the etiology of retinal periphlebitis the author demonstrates the relationship of this disease with tuberculosis. Among 73 hospital patients with retinal periphlebitis, 44 showed evidence of active tuberculosis of the hilus or pulmonary parenchyma. The anterior segment of the eye was involved in 12 percent of the cases, mainly in the form of iridocyclitis. In 23 percent the choroid was diseased. Proof of the tuberculous etiology of retinal periphlebitis is further revealed by the favorable results of antituberculosis treatment in these cases, as well as by the focal ocular reactions of tuberculin therapy. Charles A. Perera.

Ziporkes, Joseph. **Angioid streaks and pseudoxanthoma elasticum.** Arch. of Ophth., 1940, v. 24, Sept., pp. 473-475.

Both fundi of a woman aged 22 years presented radiating, brownish-black lines extending from the disc toward the periphery. Some widened and were of irregular caliber, some were wavy, some branched and still others anastomosed, so that nasally there was an appearance of network. All streaks were situated beneath the retinal blood vessels and seemed to be on the same level. In each fundus the central half surrounding the disc presented a cloudy grayish appearance, which was accentuated in the neighborhood of the macula. Just temporal to the macula was a profuse conglomeration of small pigment clumps. The fovea, however, was free of pigment. There were no hemorrhages in the retina, and the blood vessels were normal. Typical lesions of

pseudoxanthoma elasticum were present in the folds of the skin of the neck and axillas. The nature of these streaks is discussed. The appearance of the fundus is shown in a drawing.

J. Hewitt Judd.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Bhaduri, B. N. **Sodium-nitrite therapy in retrobulbar neuritis.** Calcutta Med. Jour., 1939, v. 36, Dec., p. 379.

Bhaduri reports a series of six cases in which sodium nitrite in distilled water was given intravenously. In every case blood pressure was noted before injection. Marked improvement was found in five of the six cases. Duration of dimness of vision varied from eight days to two years.

Edna M. Reynolds.

Cibis, Paul. **Clinical appearance and anatomy of drusen formation in the papilla and its combination with a melanorsarcoma of the choroid.** Klin. M. f. Augenh., 1940, v. 105, July, p. 78.

A woman of 36 years with normal vision showed irregular nodular swellings of both papillae. Visual fields revealed disseminated small absolute and relative scotomas. In another case the left eyeball of a man of 38 years was sent in for histologic examination of a melanosarcoma of the choroid. It also showed drusen of the papilla. Microchemical reactions proved them to be accumulations of hyaline material. This condition which has been found in a child of nine years, is not a senile change, but may be due to general disturbance of albumen metabolism, a disposition to hyaline or amyloid formation.

C. Zimmermann.

Duggan, J. N. **Two unusual cases of quinine poisoning.** Acta Ophth. Orientalia, 1940, v. 2, Jan., p. 56.

A nine-year-old girl suddenly became totally blind after having swallowed 15 grains of quinine. Both retinae were edematous although the discs and blood vessels appeared to be normal. Six days later the discs became pale, and yellowish dots were seen in the macular regions. Later the vessels became contracted and ensheathed. Light perception was regained on the twelfth day. Thereafter vision gradually improved and eventually became 20/20 in each eye. The visual fields remained contracted to a 20-degree circle. The patient was seen nine years later at which time her vision had deteriorated to 6/30 and 6/24 with correction. The visual fields, however, were greatly expanded. The discs were white, the arteries reduced to mere threads. No scotoma for red or green was noted, but blue was not perceptible.

A 21-year-old Hindu boy became blind after having swallowed 240 to 300 grains of quinine in a single dose. Both fundi were ischemic, the nerve heads pale, the arteries contracted, and a cherry-red spot was seen in the macula. Five days later the discs appeared slightly hyperemic with blurred margins. The retinae around the discs were edematous. The arteries and veins were normal. There was no light perception. Ten days later the discs became atrophic, the arteries contracted. Ten months later the discs were chalk-white, the arteries contracted and ensheathed, but the vision was 6/9 in each eye. Visual fields were greatly restricted. There was no scotoma for red, but green was not recognized.

R. Grunfeld.

Elwyn, Herman. **Calcified carotid artery with atrophy of the optic nerve, cupping and low tension.** Arch. of Ophth., 1940, v. 24, Sept., pp. 476-478.

A man aged 72 years presented the ophthalmoscopic and clinical appearance of chronic simple glaucoma with atrophy of the optic nerve, marginal cupping, a halo, and bilateral nasal defects with constriction of the temporal fields. The history of a persistently normal intraocular tension during the entire course of the disease led to the suspicion that this case might be one of atrophy of the optic nerve with calcified carotid arteries. This was confirmed by roentgen examination. Whether the atrophy of the optic nerve was due to pressure on the optic nerve by the calcified artery or due to a loss of nutrient vessels could not be decided from the clinical examination.

J. Hewitt Judd.

Paufique, L. **Bilateral retrobulbar neuritis, first sign of a pernicious anemia.** Bull. Soc. d'Opht. de Paris, 1939, Feb., p. 144.

The ophthalmic findings in this case called attention to the general condition and added optic neuritis to the other elements of the neuro-anemic syndrome. It is exceptional to observe visual troubles dominating the clinical scene in the early stages of pernicious anemia, and the affection of the optic nerve may be unperceived in the picture of retinitis. Jerome B. Thomas.

Puech, P., Bonnet, R., and Guillaumat, L. **Leber's disease cured by a neurosurgical operation.** Bull. Soc. d'Opht. de Paris, 1939, Feb., p. 116.

The case report of a young man with hereditary optic atrophy. All medical treatment failed, as is the rule in this condition. An intracranial operation relieved the optic nerves and chiasm of the thickened arachnoid membrane which pressed upon them. Following this operation and continued medical treatment, slow but progressive improvement took place, and at the end of two years the visual acuity of each eye had risen from 1/50 to 10/10. This slow improvement contrasts with the occasional brilliant and immediate results of surgical intervention in certain cases of opticochiasmatic arachnoiditis, which often fail to persist. In another case reported by Bollack, David, and Puech the authors insisted on the coexistence of Leber's disease and opticochiasmatic arachnoiditis, and on the slight differences that exist between the two affections apart from the familial nature of the hereditary atrophy. Surgical verifications may in time cause a change in the classification of certain optic atrophies. (2 figures.)

Jerome B. Thomas.

Shone, S. **A case of neuromyelitis optica.** Indian Med. Gazette, 1940, v. 75, Sept., p. 548.

A Hindu girl of seven years suffered from sudden blindness, loss of speech, and paralysis of both legs. Complete recovery occurred after one month with no treatment but rest in bed. With admission that many discrepancies clouded his diagnosis, the author labels the case one of neuromyelitis optica.

Morris Kaplan.

Sourdille, G. P., and David, M. **Rare modes of compression of the intracranial optic nerve.** Bull. Soc. d'Opht. de Paris, 1939, March, p. 183.

Reports of two cases with intracranial compression of the optic nerve, one by a neuroma of the acoustic nerve and

the other by an atheromatous plaque located at the bifurcation of the carotid artery. Jerome B. Thomas.

Sutherland-Campbell, H. **Value of tryparsamide in the treatment of atrophy of the optic nerve due to syphilis.** Arch. of Ophth., 1940, v. 24, Oct., pp. 670-680.

Since certain authorities have again advocated the use of tryparsamide for the treatment of neurosyphilis despite the presence of optic atrophy, the author reviews the literature and finds that the use of tryparsamide in these cases should be condemned, as the considered opinion of the majority indicates that the use of tryparsamide in the relatively few cases of tabes or of paresis of the tabetic type in which primary atrophy of the optic nerve occurs is not justified in the light of its dangerous potentialities. While the purely syphilitic amblyopic process is usually slowly progressive, a case is reported to show that it may sometime be acute, as this patient became blind within a period of three weeks.

J. Hewitt Judd.

Terrien, F., Azerad, E., and Voisin, J. **A case of retrobulbar neuritis purely diabetic in origin.** Bull. Soc. d'Opht., de Paris, 1939, Feb., p. 111.

Report of a case of diabetic retrobulbar neuritis in a man of 45 years. The prognosis in such cases has been considered grave, but with adequate treatment of his diabetes the patient regained his normal weight and returned to his work. The author notes that insulin therapy has rendered rare this ocular complication of diabetes.

Jerome B. Thomas.

Worster-Drought, C., and Shafar, J. **Observation on megacolon (Hirschsprung's disease) with special reference to an association with changes in the fundus oculi and hydrocephalus.** Brit. Jour. Children's Dis., 1940, v. 37, July-Sept., p. 153.

A boy of eight years suffered from congenital megacolon. Also present were congenital internal hydrocephalus and advanced bilateral optic atrophy. The authors attempt to explain the megacolon as a result of hydrocephalus, while the optic atrophy was obviously a direct result of it.

Morris Kaplan.

12

VISUAL TRACTS AND CENTERS

Adrogué, Esteban. **Considerations on the homonymous hemianopsias.** Arch. de Oft. de Buenos Aires, 1939, v. 14, July, p. 584.

This thesis presents a thorough review of the subject, under the following headings: anatomical data, retinal projection on the area striata, classification of hemianopsic defects, symptoms accompanying hemianopsia, hemianopsia of vascular origin, interference with the visual pathways by cerebral tumors, classification of hemianopsia according to the site of the lesion, cortical blindness, double hemianopsia, conjugate deviation and hemianopsia, scintillating scotoma, migraine and hemianopsic hallucinations, and anatomic and etiologic considerations in double hemianopsias. (Bibliography.)

Plinio Montalván.

Henderson, J. W., and Rucker, C. W. **Bitemporal hemianopsia of traumatic origin.** Arch. of Ophth., 1940, v. 24, Oct., pp. 800-802.

After a head injury in an automobile accident causing unconsciousness for two weeks, the patient on regaining

consciousness noted diplopia and an inability to see in the temporal fields. The diplopia disappeared after one month, but the absolute bitemporal hemianopsia persisted. In some fractures of the frontal bone, the brain may be so suddenly and violently displaced as to cause multiple minute tears in the crossing bundles with sparing of the noncrossing bundles in the chiasm and consequent bitemporal hemianopsia.

J. Hewitt Judd.

Mastier, P., and Farnarier, G. **Retinal arteritis causing horizontal bilateral, symmetrical hemianopsia.** Bull. Soc. d'Opht. de Paris, 1939, March, p. 197.

A case report with two illustrations.

Schousboë, F., and Sarrouy. **Ocular symptoms of hypophyseal origin in the course of Basedow's disease.** Bull. Soc. d'Opht. de Paris, 1939, March, p. 191.

For two years the authors observed a patient suffering from Basedow's syndrome. They were impressed from the first by the existence of a leucomelanodermia which according to the patient had increased since the appearance of the phenomena of hyperthyroidism. Symptoms of cardiac insufficiency having been noted, the patient was put upon cardiac treatment. Two signs pointed to the gravity of the case and the insufficiency of therapeutic measures adopted up to that time, namely the gravity of the cardiac disturbance and the progressive elevation of the basal metabolism. These facts caused the authors to propose operation on the thyroid. But the discovery of bitemporal retraction of the visual fields called attention to the diencephalic centers. The presence of pigmentary phenomena pointed in the same direction, as did the fact that Risak had discussed the possibility of hyperthyroidism of cerebral origin. Radiotherapy was instituted, with the result of rapid amelioration in several symptoms of the syndrome, including enlargement of the visual fields and improvement of the cardiac disturbances.

Jerome B. Thomas.

13

EYEBALL AND ORBIT

Berliner, M. L., and Gartner, S. **Hypertelorism.** Arch. of Ophth., 1940, v. 24, Oct., pp. 691-697.

Hypertelorism is a congenital anomaly of the skull and face characterized by wide separation of the orbits. The anomaly is believed to be due to an enlargement of the lesser wings of the sphenoid bone. A case of hypertelorism is reported in which the interpupillary distance was 84 mm. and there was a right exotropia of 140 prism diopters. There was pallor of the right disc with concentric contraction of the visual field. Roentgenograms showed anomalous arrangement of the orbits with narrowing and distortion of the optic canals.

J. Hewitt Judd.

Carruth, H. E. **Evisceration operation—a modification.** Trans. Pacific Coast Oto-Ophth. Soc., 1939, 27th mtg., pp. 205-207.

The author believes that his modification provides a safety factor against infections traveling along the nerve sheaths, and gives a more movable and efficient stump. After peritomy of the conjunctiva and making a deep separation just below the internal rectus, the optic nerve and vessels are isolated with a squint hook and clamped, the cornea is removed, the globe exenterated, and the nerve is cut in front of the clamp. The scleral sac is then everted with a

tonsil screw, bringing the nerve head into full view so that the nerve and surrounding tissues, including the ciliary nerves, can be removed. The scleral sac is replaced and an implant may or may not be used. The sclera is closed with a purse-string suture, and the conjunctiva with interrupted sutures after removing the nerve clamp.

Lawrence G. Dunlap.

Holt, H., and Rötth, A. de. **Orbital-apex and sphenoid-fissure syndrome.** Arch. of Ophth., 1940, v. 24, Oct., pp. 731-741.

The literature is reviewed and three cases are reported, two of orbital-apex and sphenoid-fissure syndrome and one of purely sphenoid-fissure syndrome due to infection. The first, or complete, syndrome involves the second, third, fourth, first division of the fifth, and sixth cranial nerves and sympathetic fibers. The second, or incomplete, syndrome spares the optic nerve. A fourth case is described in which the complete syndrome was produced during the development of an intracranial tumor. It is important to distinguish early between an infectious process and a new growth, so that the patient will not be unnecessarily submitted to an intracranial operation in the one case and so that compression of the optic nerve may be relieved in the other.

J. Hewitt Judd.

Kalt, E. **Facial and orbital actinomycosis.** Bull. Soc. d'Opht. de Paris, 1939, March, p. 167.

Report of a case of facial and orbital actinomycosis illustrated by three figures. In discussing the treatment of the case the author states that one should not depend entirely upon medical treatment. It is advisable to remove the tumors in their early stages if possible, as one would do with malignant tumors.

Jerome B. Thomas.

Posner, I., and Piatt, A. D. **Ocular hypertelorism with cleft palate and giant-cell tumor.** Radiology, 1940, v. 35, July, p. 79.

The authors describe the case of a four-year-old boy with ocular hypertelorism associated with cleft palate, harelip, mental retardation, cerebral birth palsy, and a giant-cell tumor of the right femur. The eyes showed a rotatory nystagmus and divergent squint. The vision of the right eye was 6/20 and the left 6/50. The exophthalmic reading was 20 mm. for each eye. The interpupillary distance measured 62 mm. The small wings of the sphenoid were markedly enlarged.

John C. Long.

Seidenari, Renato. **Interrelation between nasal and ocular diseases.** Riv. Oto-Neuro-Oft., 1939, v. 16., July-Oct., pp. 345-352.

This is a chronologic critical review of the association of diseases of the nose and its sinuses, and the eye and its adnexa. Ali-Ibn Isa, who lived in the eleventh century, is mentioned as the first to note this relationship.

M. Lombardo.

Young, J. H. **Rare ocular developmental anomalies in association with congenital and acquired blindness.** Brit. Jour. Ophth., 1940, v. 24, Dec., pp. 597-610.

In this report of a single case, numerous rare and complex congenital ocular abnormalities are described in detail. There was an extensive history of severe myopia in the family, with mental deficiency in a number of cases. Bilateral blindness of congenital origin was present in two children. Following a routine enucleation the patient devel-

oped emboli from an unsuspected bacterial endocarditis and died. (Figures, tables, references.) D. F. Harbridge.

14

EYELIDS AND LACRIMAL APPARATUS

Berens, Conrad. **Single-ended and double-ended metal spatulas.** Amer. Jour. Ophth., 1941, v. 24, Jan., p. 66.

Bonnet, P. **Fracture of the frontal sinus.** Bull. Soc. d'Opht. de Paris, 1939, Jan., p. 83.

Reports of two cases, one presenting late serious inflammatory complications about 15 years after the fracture; the other, followed almost at once after the fracture, by emphysema of the lids.

Jerome B. Thomas.

Bussy, Juliette. **Aspect of a chancre of the upper lid.** Bull. Soc. d'Opht. de Paris, 1939, Feb., p. 149.

The patient was a man of 63 years. The affection of the upper lid began as a small button about two weeks before the oculist was consulted, by which time it had increased to a large ulcerated mass with indurated base and extensive edema of the lid. After six weeks under local treatment with yellow oxide of mercury ointment only a scar remained, with a slight loss of substance of the border of the lid. In the discussion following this report it was noted that grave and rapid cerebral complications might follow chancre of the lids or conjunctiva.

Jerome B. Thomas.

Dollfus, E. J., Courtial, and Desvignes, P. **Meibomian epithelioma of unusual appearance.** Bull. Soc. d'Opht. de Paris, 1939, Jan., p. 23.

A small tumor of the free border of the lid ulcerated and gradually caused ectropion. The development occupied about 12 years, going through phases of ulceration and cicatrization before biopsy of the conjunctival cushion revealed its epitheliomatous nature. As the glands of Meibomius and of Zeiss are both sebaceous, it is impossible to state in which of them the tumor originated. Jerome B. Thomas.

Handman, M. **Isolated aplasia of the tarus of the upper lid as congenital, perhaps hereditary malformation.** Klin. M. f. Augenh., 1940, v. 104, June, p. 750.

In a woman of 29 years the tarsus of the left upper lid was well formed and had a vertical diameter of 8 mm. The right upper lid was difficult to evert. After eversion a round mass was seen in the tarsal area. This was covered by normal conjunctiva without any cicatricial band or sign of former operation. Nothing could be seen of the Meibomian glands. The author mentions another case of aplasia of the tarsus in a man of 39 years. C. Zimmermann.

Jacoby, Julius. **Toti's operation and its advantages from personal experience.** Acta Ophth. Orientalia, 1940, v. 2, Jan., p. 51.

The author describes in detail the operative technique used by Toti and claims its superiority over West's operation. With Toti's method the operation is painless and of comparatively short duration and one has absolute control over the operative field. Among the twenty operations the author has recently performed, three are of special interest. (1) Bilateral dacryocystitis in a child of one year was histologically diagnosed as of tuberculous origin. The operation was successful and the wounds healed primarily. But the operation was followed by other manifestations of tuberculosis: swelling of the lymph glands, and

fistulous skin ulcerations of the legs, all of which healed spontaneously. (2) Toti's method was successful in a case where West's operation had failed. (3) A small splinter left in the wound caused fistulization for three weeks and its removal was followed by prompt healing. The author urges the careful removal of all small splinters, and condemns trephines and drills which inevitably cause fine splinters detectable only with difficulty. R. Grunfeld.

Kamel, Sabri. **A new knife for doing Van Millingen grafting operation.** Brit. Jour. Ophth., 1940, v. 24, Nov., pp. 567-570.

The knife is intended to overcome the faults of the Landolt scalpel in such operations as the Van Millingen grafting operation in certain cases of trichiasis. In making the intermarginal groove into which the graft fits, which, in the opinion of the author, is the fundamental point upon which the operation is based, difficulty is experienced with the Landolt scalpel especially in working on the left eye. The longer handle of the new knife with its shorter blade set at an angle of 120 degrees offsets the difficulties described. (Illustrations.) D. F. Harbridge.

McGovern, F. H. **Paroxysmal lacrimation during eating following recovery from facial paralysis.** Amer. Jour. Ophth., 1940, v. 23, Dec., pp. 1388-1390.

MacLean, J. M. **Plastic reconstruction of the upper lid.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 46-48.

Meek, R. E. **An operation for spastic entropion.** Arch. of Ophth., 1940, v. 24, Sept., pp. 547-551.

A skin incision is made 3 mm. below the margin of the lid and the skin undermined 1 mm. toward the lid margin and 3 mm. toward the orbital rim. Two flaps of orbicularis muscle, each 4 mm. in width and tapering at each end, are first outlined with a knife and then dissected up from the tarsus, leaving a central area of 7 mm. still attached to the tarsus with its center just temporal to the center of the lower margin of the lid. An incision is made with the knife 25 degrees temporal from a point below the center of this attached muscle down to the anterior surface of the inferior orbital margin, and the muscle flap loosely sutured in place on the anterior surface of the inferior orbital margin. A similar incision is made 25 degrees nasal to the center of the attached muscle. The other flap is sutured loosely in place on the anterior surface of the nasal orbital margin. The steps of the operation are shown by drawings. (Discussion.) J. Hewitt Judd.

Nicolacopoulos, J. **Regarding 360 cases of dacryocystorhinostomy.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 263.

Of 360 unselected cases, 352 (98.33 percent) were reported as cured. The type of operation used was that advocated by Dupuy-Dutemps and Bourguet. George A. Filmer.

Nižetić, Z. **Considerations on the surgery of the tear-conducting paths.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 217.

From his experience with 170 cases the author is convinced that the present operative treatment of obstructions and chronic affections of the tear passages represents great progress. He discusses the operative technique of extirpation of the lacrimal sac and of dacryocystorhinostomy with the different modifications. (3 case reports.)

C. Zimmermann.

Pokhisov, H. I. **Surgery of the lacrimal passages in stenosis of the lacrimal canaliculi.** Viestnik Opht., 1940, v. 16, pt. 5, p. 356.

In traumatic stenosis of the inferior lacrimal canaliculus, epiphora is present in spite of the patency of the superior lacrimal canaliculus. This is because in the upright position the superior punctum is slightly everted and therefore does not function. The author excises a piece of conjunctiva from the upper lid around the upper lacrimal punctum. This procedure places the upper punctum in closer opposition with the eyeball and increases its function to the extent of complete cessation of epiphora. Ray K. Daily.

Rötth, Andrew de. **On the hypofunction of the lacrimal gland.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 20-25.

Vengrshenovski, T. C. **A case of acute bilateral dacryoadenitis.** Viestnik Opht., 1940, v. 16, pt. 5, p. 380.

Vengrshenovski reports a rare and severe case of febrile bilateral dacryoadenitis with involvement of the parotid and submaxillary glands. The most severe and prolonged swelling was that of the lacrimal glands which were palpably enlarged and tender. The patient had had a similar attack one year before, and several years previously a brother had died of the same disease.
Ray K. Daily.

15
TUMORS

Aurand. **Bilateral choroidal metastasis of a cancer of the breast.** Bull. Soc. d'Opht. de Paris, 1939, Feb., p. 136.

The report concerns partial bilateral detachment of the retina due to a bilateral metastatic carcinoma of the choroid, appearing four months after a cancer of the breast had recurred and had been promptly re-operated. The points most emphasized by the author are the slight importance of the early visual symptoms and the necessity of careful examination of the eyes of all cancer patients whether operated on or not, and even though visual trouble may seem slight. Jerome B. Thomas.

Bonnet, P. **Venous tumor of the internal angle of the orbit, communicating with the intracranial venous sinuses.** Bull. Soc. d'Opht. de Paris, 1939, Jan., p. 85.

Clinical report of a case of venous tumor of the internal angle of the orbit in a girl 13 years old, describing the differential diagnosis and treatment by operation. The tumor was bluish in color, about the size of a small cherry, was compressible with the finger, which also revealed beats synchronous with the pulse. The tumor had the form of a venous ampoule at the point of discharge of the facial into the ophthalmic vein. Dissection of the vein led to a pedicle, deep in the wound, which communicated with the superior longitudinal sinus. There was severe bleeding from the pedicle after slipping of the ligature and the wound was closed with pressure tampons.
Jerome B. Thomas.

Bonnet, P., and Paufique, L. **Unilateral exophthalmos caused by a tumor of the orbit, the metastasis of a latent cancer of the prostate.** Bull. Soc. d'Opht. de Paris, 1939, Jan., p. 63.

The metastases present themselves in two forms: (1) intraorbital metastatic tumor, developed within the periosteal sac at the expense of the soft parts, (2) parieto-orbital tumor developed in the bony tissue of the orbital wall. The importance of radiography

of the pelvis in the diagnosis of cancer of the prostate is stressed. (Case report.) Jerome B. Thomas.

Brons, Hilari. **Clinical appearance and histology of congenital melanosis bulbi.** Klin. M. f. Augenh., 1940, v. 105, July, p. 55.

In order to determine whether a malignant tumor may develop from congenital melanosis of the eye, Brons re-examined ten cases at the eye clinic of Tübingen. He gives detailed descriptions. In none was a malignant new-formation from the melanosis found.

C. Zimmermann.

Cibis, Paul. **Clinical appearance and anatomy of drusen formation in the papilla and its combination with a melanosarcoma of the choroid.** Klin. M. f. Augenh., 1940, v. 105, July, p. 78. (See Section 11, Optic nerve and toxic amblyopias.)

Dollfus, M. A. **Therapeutic results of 100 cases of palpebral epithelioma treated by irradiation at the Radium Institute of Paris, 1935 to 1937.** Bull. Soc. d'Opht. de Paris, 1939, Jan., p. 27.

The author's conclusions follow: Treatment by irradiation, particularly by radium, acts perfectly in epithelioma of the lids, effecting complete cicatrization and excellent cosmetic results. However, the treatment must be conducted by trained medical specialists, with particular consideration of the danger of ocular complications. These may be avoided in most cases if one operates only upon patients who have had no previous irradiation, and if one gives first and in one treatment a sufficient dose to obtain sterilization of the neoplastic lesion. Finally the patients should be kept under observation, with visits every few months. In case of recurrence of the growth, surgery or electrocoagulation will effect a cure. Among the one hundred cases treated there were only two definite recurrences. Jerome B. Thomas.

Friedman, Benjamin. **Choroidal "perithelioma" simulating retrobulbar neuritis.** Arch. of Ophth., 1940, v. 24, Oct., pp. 765-771.

In a woman aged 64 years, visual-field changes and nasal findings led to an erroneous diagnosis of retrobulbar neuritis due to sinus disease. The tumor became evident ophthalmoscopically eight months after the initial complaint. It enlarged very rapidly, increasing in elevation from 1 to 8 diopters in less than four months. No abnormality of the macula which would account for a defect of the central field could be seen ophthalmoscopically, but microscopic examination revealed shallow detachment of the retina in the region of the macula caused by fluid exuding beyond the margins of the tumor. Microscopically the tumor was found to correspond most closely to a perithelioma, a tumor which belongs to the epithelioid melanomas. J. Hewitt Judd.

Jensen, A. F. **Bilateral metastasis to the eye following carcinoma of the breast.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 63-66.

Smith, Carroll. **Ocular lymphocytoma.** Trans. Pacific Coast Oto-Ophth. Soc., 1939, 27th mtg., pp. 214-222.

A left unilateral ocular lymphocytoma occurred in a female school teacher aged 23 years. The condition had been present for six months and showed many irregularly sized (from 1 to 3 mm.) and shaped follicles of firm consistency in the lower cul-de-sac. Vernal catarrh and other possible conditions

were ruled out and biopsy showed it to be a lymphocytoma. The patient improved under X-ray treatments.

Lawrence G. Dunlap.

Souders, B. F. **Transcranial extirpation of a fibrohemangioma of the orbit.** Arch. of Ophth., 1940, v. 24, Sept., pp. 539-543.

A man aged 34 years presented unilateral exophthalmos, which clinically appeared to be due to a benign tumor in the posterior portion of the left orbit. Because of its apparent posterior location, a transfrontal approach was made which allowed complete removal of an encapsulated fibrohemangioma of the posterior orbit. J. Hewitt Judd.

Stallard, H. B. **Metastatic carcinoma of the iris; clinically simulating gumma.** Brit. Jour. Ophth., 1940, v. 24, Nov., pp. 541-547.

As an example of the uncertainty of diagnosis even when based upon very substantial clinical facts and signs, a case of metastatic carcinoma of the left iris, resembling gumma, is described. Metastatic carcinoma of the uveal tract is rare, and especially as relates to the iris. The patient died from multiple metastases to the brain and viscera. (Figures, references.)

D. F. Harbridge.

Tsopelas, B. **Anatomic aspects of two cases of malignant tumor in the region of the eye.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 250.

Both cases were treated by exenteration of the orbit followed by roentgen radiation. The first case was of fusiform-cell sarcoma causing exophthalmos; the second was of carcinoma extending into the orbit from the malar region. George A. Filmer.

Tüshaus, Rainer. **Prognosis of retinal glioma and uveal sarcoma.** Klin. M. f. Augenh., 1940, v. 105, July, p. 41.

The investigations were as to the fate of thirty patients whose enucleated eyes had been examined at the pathologic institute of Düsseldorf during the last ten years. If the patients could not be re-examined, questions regarding their fate were sent to physicians or relatives. Of ten patients with glioma, seven had shown the disease in the first to third year of life, two in the fourth to sixth year, and one at the age of 34 years. Nine patients whose globes had been enucleated at an early stage of the disease remained free from relapse or metastasis nine years later. Nineteen cases of sarcoma are discussed. Early enucleation is recommended, although even then the probability of metastasis is great. C. Zimmermann.

16

INJURIES

Battignani, Agostino. **Vogt's boneless radiography.** Boll. d'Ocul., 1939, v. 18, Dec., pp. 958-964.

Vogt's method for the detection of radiopaque intraocular foreign bodies showed the foreign body in two cases in which the usual method had given negative results. (Bibliography, 7 figures.) M. Lombardo.

Bonnet, P. and Chauviré. **Contusion of the globe; appearance of hole in the macula.** Bull. Soc. d'Opht. de Paris, 1939, Feb., p. 152.

A successful operation for iridodialysis was performed on the patient, a nine-year-old child. Upon the basis of long experience, the authors strongly recommend this operation for its effectiveness, simplicity, and freedom from reaction. Jerome B. Thomas.

Bristow, J. H. **Temporary myopia due to sulphanilamide.** Arch. of Ophth., 1940, v. 24, Oct., pp. 799-800. (See Section 2, Therapeutics and operations.)

Campailla, Giuseppe. **The sphenoidal-fissure syndrome.** Riv. Oto-Neuro-Oft., 1939, v. 16, July-Oct., pp. 279-302.

A woman of 36 years, who had sustained a severe blow in the right frontal region two months previously, developed violent headaches and right ptosis. The right eye showed complete ophthalmoplegia from paralysis of the third, fourth, and sixth nerves, and the pupil did not react to light. These symptoms were accompanied by corneal hypesthesia and anesthesia of the territory supplied by the ophthalmic nerve. The motor and sensory symptoms improved after antiluetic treatment and spinal punctures. A woman of 56 years fell from a bicycle striking her head. After 15 days she developed left parietal and supraorbital headaches together with ophthalmoplegia and sensory disturbances, as in the other case. These symptoms disappeared after antiluetic treatment and spinal punctures. The author emphasizes the importance of antiluetic treatment even in nonluetic cases. (Bibliography, 8 figures.) M. Lombardo.

Charamis, J. S. **Foreign body remaining in the anterior chamber for seven years.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 302.

A small piece of stone had remained in the anterior chamber for seven years without any ocular reaction. It was uneventfully removed.

George A. Filmer.

Dashevski, A. I., and Marmostein, F. F. **Surgical treatment of chemical ocular burns.** Viestnik Opht., 1940, v. 16, pt. 6, p. 415.

This laboratory investigation on rabbits demonstrates the effectiveness of transplanted cadaver conjunctiva in sulphuric-acid burns of the cornea. The transplant has no plastic effect, per se, because it is eventually absorbed, but the products of its destruction have a stimulating effect on the regeneration of the ocular conjunctiva.

Ray K. Daily.

Davidson, M. **The evolution of lens lesions in eye perforation and ruptures.** Amer. Jour. Ophth., 1940, v. 23, Dec., pp. 1358-1375.

Evans, J. J. **Cerebral fat embolism with recovery: and involvement of the central retinal artery.** Brit. Jour. Ophth., 1940, v. 24, Dec., pp. 614-616.

Recovery is rare in instances of cerebral fat embolism. In the case reported there were bruises and lacerations on the right arm with an oblique fracture of the right ulna extending to the elbow joint, fractures of the right tibia and fibula with considerable displacement, and a fracture of the right patella. Ether was used in reducing the fractures. The patient sank into a coma and showed a petechial rash on the chest and neck, and a transient squint in the left eye. Lumbar puncture revealed clear fluid under normal pressure. Fat globules were found in the urine with a high percentage of fatty acids in the blood. There was involvement of the retinal arteries in both eyes. The eyes recovered completely within two months. (Photomicrograph, references.) D. F. Harbridge.

Fanta, H. **Detachment of the retina and accident.** Klin. M. f. Augenh., 1940,

v. 105, July, p. 30. (See Section 10, Retina and vitreous.)

Fink, M. B. **Bilateral burn of the eyes with hot sand.** Viestnik Opht., 1940, v. 16, pt. 6, p. 509.

A severe burn of the lids and conjunctiva made complete recovery without deformity under treatment with an ointment containing vitamins A and D.

Ray K. Daily.

Heinsius, E. **Injury of the eye by mustard gas (dichlordiethyl sulphide).** Klin. M. f. Augenh., 1940, v. 104, July, p. 15.

The author experimented on rabbits with this substance. The resulting injuries showed a more severe course than did the gas injuries of soldiers during the World War. This was probably due to greater concentration of the substance as used in the experiments. The different stages are described, especially the formation after three weeks of blisters on the cornea due to exudation and separation of the upper parenchymatous layer.

C. Zimmermann.

Holst, J. C. **Traumatic retinal detachment.** Acta Ophth., 1940, v. 18, pt. 2, p. 190. (See Section 10, Retina and vitreous.)

Jung, J. **Keratoconus and injury.** Klin. M. f. Augenh., 1940, v. 105, July, p. 26. (See Section 6, Cornea and sclera.)

Knapp, F. N. **Ophthalmia nodosa.** Arch. of Ophth., 1940, v. 24, Sept., pp. 535-538.

The literature is briefly reviewed and the case of a woman aged 35 years is reported in which irritation and nodules occurred after exposure to hairy moss. The nodules rapidly disappeared after the injection of a solution of mercuric oxycyanide (1 to 1000). Microscopic examination of the granulomatous tissue revealed structures that appeared to be plant hairs. There was no recurrence. (1 color photograph, photomicrographs.) J. Hewitt Judd.

Lindeman, Olaf. **Peculiar vascular changes in a case of traumatic angiopathy of the retina,** Klin. M. f. Augenh., 1940, v. 104, June, p. 740.

A laborer, injured in an automobile accident, sustained severe contusion of the right side of the chest with fracture of ribs on the right side and intrathoracic hemorrhages. A day later he complained of poor vision. Both eyes showed the characteristic changes of traumatic angiopathy of the retina: white foci, edema of the retina, hemorrhages, changes at the macula, and disturbance of the visual fields. The blood pressure was elevated. Later glaucoma, probably secondary to thrombosis of the retinal veins, developed. Trephining was performed but the patient became blind. C. Zimmermann.

Lindner, K. **Extraction of nonmagnetic ophthalmoscopically visible foreign bodies from the eye.** Klin. M. f. Augenh., 1940, v. 104, June, p. 670.

After locating the foreign body with the ophthalmoscope the meridian in which it is located is marked by a dot of gentian violet at the limbus, and a radial incision is made incompletely through the sclera, leaving the deepest layer of fibers intact. A silk suture is inserted through each side of the scleral wound so that traction may be made to relieve pressure on the vitreous. The intact scleral layer is electrocoagulated

by a button electrode and then incised. The foreign body is located through the gaping wound by direct illumination and extracted with forceps.

C. Zimmermann.

MacFadyen, John. **Rupture of the posterior ciliary arteries in eye injuries by blunt objects.** Ophthalmologica, 1940, v. 100, Sept., p. 9.

The author describes the eyes of two patients in whom the fundus picture was ascribed to rupture of the posterior ciliary arteries. In each of them, a blunt injury was the cause of disturbance. In the first patient, who had been struck in the eye by a football, a pale area of retina about the disc could be seen on the second day despite vitreous hemorrhage. Six months later vision was 6/9 with a paracentral scotoma and a pale spottily pigmented area of fundus around the disc. The other patient was struck in the eye with a golf club. When healed, there was evidence of choroidal rupture and some proliferated connective tissue in the affected region of the retina. F. Herbert Haessler.

Marioth. **Disturbance of the function of the hypophysis from fracture of the sella turcica.** Graefe's Arch., 1939, v. 141, pts. 2 and 3, pp. 188-197.

The author describes the case of a 19-year-old youth who was injured in a motorcycle accident and showed bilateral abducens paresis, and traumatic retinal angiopathy. Roentgenograms revealed a fracture of the left side of the floor of the sella turcica. Atrophy of the left optic nerve and transient diabetes insipidus ensued. Several months after the injury the patient revealed evidences of gigantism and acromegaly of the hands and feet. Marioth quotes from a report made in 1905 by Bleibtreu of the case of a 21-year-old patient who developed gigantism and beginning acromegaly after a fall. The author attributes the skeletal changes in his case to eosinophilic hyperplasia of the anterior pituitary gland. In a review of the literature of hypophyseal trauma, he shows that many of the cases reported developed symptoms of hypofunction of the pituitary gland.

Charles A. Perera.

Meisner, T. **Topography and complications of penetrating injuries of the anterior segment of the eye.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 198.

Meisner studied the clinical reports of 249 penetrating eye injuries seen at the University Clinic of Munich from 1930 to 1939 (excluding ruptures and gunshot wounds), with regard to location of the wound, and frequency of involvement of the lids and deeper tissues. Of these, 173 (about 70 percent) were caused by pieces of iron, stone, wood, bone, or glass, and 76 (30 percent) by pointed or sharp objects. Injuries to deeper structures as related to the external wounds are discussed.

C. Zimmermann.

Mielke, Sophus. **The mechanism of spontaneous expulsion of intraocular pieces of copper.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 207.

Spontaneous expulsion of intraocular foreign bodies usually occurs at the 6-o'clock position near the limbus. Migration is the result of changes in the tissues by chemotaxis from attracted leucocytes. C. Zimmermann.

Nasarov, V. V. **Perforating ocular injuries in the Kuban eye clinic for a period of 25 years.** Viestnik Opht., 1940, v. 16, pt. 5, p. 374.

An analysis of 1,315 perforating injuries which constituted 0.59 percent

of the entire clinical material. Of these cases, 444 were of children under 15 years of age. The majority of injuries in adults were occupational. Only 14.7 percent of the injuries recovered with vision over 0.1. The author urges a prophylactic program including educational campaigns in the schools, factories, and hunting clubs; and training of rural physicians in proper first-aid methods for ocular injuries.

Ray K. Daily.

Puglisi-Duranti, G., and Rebaudi, F. **Clinical and therapeutic considerations on bullet wounds of the occipital region.** Riv. Oto-Neuro-Oft., 1939, v. 16, July-Oct., pp. 303-310.

Two young men were wounded in action, the bullet coming from a distance of about 300 meters in the first case and from about 500 meters in the second. Entrance and exit wounds were situated at the same level on each side of the posterior section of the head. The first patient, who was at first totally blind, regained some central vision after four months, when a clot exerting pressure on the tissue around the calcarine fissure was absorbed. In the second case the bullet penetrated the skull at the posterior border of the temporal bone and provoked a bilateral papilledema. Increased intracranial pressure due to hemorrhage was found by spinal puncture. Autopsy revealed a basal skull fracture with great destruction of the brain and third ventricle. The authors discuss the severity of such wounds in relation to the distance which the bullet travels. (2 figures.)

M. Lombardo.

Rameev, P. C. **Chemical ocular injuries.** Viestnik Opht., 1940, v. 16, pt. 5, p. 381.

A report of nine cases of chemical injury caused by inadvertent instillation of tincture of iodine, tincture of opium, strong ammonia, strong solutions of silver nitrate, nitric acid, and crystals of potassium permanganate. In all but two cases the injury was insignificant. The nitric-acid burn left an opaque cornea, and potassium permanganate caused conjunctival necrosis with subsequent symblepharon.

Ray K. Daily.

Saburov, G. I. **Stereoroentgenography of intraocular foreign bodies.** Viestnik Opht., 1940, v. 16, pt. 5, p. 349.

An emphasis on the merits of Trendelenburg's stereoscopic roentgenography for foreign-body localization.

Ray K. Daily.

Schley, H. **Late results and complications after diascleral extraction of splinters of iron.** Klin. M. f. Augenh., 1940, v. 104, June, p. 675.

Anaylsis of late results indicates that after removal of foreign bodies by the anterior route opacities of the lens are more frequent, while after the diascleral operation detachment of the retina and phthisis bulbi are more apt to occur. In any case of foreign body in the vitreous, retina, or choroid, the possibility of late sequelae must be considered.

C. Zimmermann.

17

SYSTEMIC DISEASES AND PARASITES

Adam, C. **Two forms of scintillating scotoma and their prognostic significance.** Klin. M. f. Augenh., 1940, v. 105, Aug., p. 211.

After a rather strenuous tour through Italy, three participants, each about sixty years of age, complained of scintillating scotomata. Two of them died the next year of apoplexy. As the

literature did not report anything about the prognosis of scintillating scotoma in later life, Adam sent a questionnaire to a number of experienced eye and nerve specialists. According to the returns, senile scotoma is generally a symptom of disease of the cerebral vessels. The source of the disease cannot be determined by the type of the scotoma. Thus scintillating scotoma does not give a more unfavorable prognosis than does the underlying disease itself. C. Zimmermann.

Appelbaum, Alfred. **Allergic phenomena in ophthalmology.** Arch. of Ophth., 1940, v. 24, Oct., pp. 803-823.

The present knowledge of experimental and clinical allergic phenomena is discussed as to the factors influencing the incidence, their relation to focal infection, the evaluation of cutaneous reactions, and the manifestations found in the lids, conjunctiva, cornea, sclera and episclera, uvea, lens, optic nerve, retina, and muscles. At present the practical application of this knowledge is restricted to the therapeutic use of tuberculin in tuberculosis of the eye, the therapeutic use of uveal pigment in sympathetic ophthalmia, and desensitization of patients with cataract who are sensitive to lens cortex with lens protein prior to extraction of the cataract. J. Hewitt Judd.

Borsotti, I., and Pillett, P. **Examination of the fundus oculi during the course of blood transfusions.** Bull. Soc. d'Opht. de Paris, 1939, March, p. 188. (See Amer. Jour. Ophth., 1940, v. 23, Feb., p. 242.)

Feigenbaum, Aryeh. **Cerebropituitary origin of a case of a so-called cerebral pseudotumor in puberty with papilledema and other signs of increased intracranial pressure.** Acta Ophth. Orientalia, 1940, v. 2, Jan., p. 45.

In a 12-year-old boy alarming tumor symptoms (headache, vomiting, paresis of both external recti, bilateral papilledema) appeared. The signs of cerebral pressure gradually receded, but obesity developed during the next three months. Moreover, in the following three months the obesity gave way to rapid growth in height, and today at the age of 18 years the boy has developed a relative gigantism.

The author argues that the obesity was of cerebropituitary origin, secondary to a deranged water-salt metabolism. It is noteworthy that the obesity disappeared without treatment. The anterior lobe of the diseased pituitary gland liberated a great amount of growth-promoting hormone and characteristic gigantism developed at puberty. R. Grunfeld.

Geilikman, O. B., and Gitman, C. M. **Luetic ocular diseases among the Mongols.** Viestnik Opht., 1940, v. 16, pt. 6, p. 483.

Because of their low cultural level, syphilis is widespread among the Mongols. It forms 4.6 percent of the primary ocular diseases, and is responsible for 31.9 percent of all cases of bilateral blindness. Of patients with ocular syphilis, 53.7 percent lose one or both eyes. Involvement of the optic nerve represents 63.6 percent of all cases of ocular lues. This high incidence indicates a lack of antiluetic measures, and calls for an organized educational and therapeutic campaign.

Ray K. Daily.

Gralnick, Alexander. **The eyegrounds of patients with functional psychoses given insulin-shock therapy.** Amer. Jour. Ophth., 1941, v. 24, Jan., pp. 26-33.

Landegger, G. P. **Filaria loa in the eye.** Trans. Pacific Coast Oto-Ophth. Soc., 1939, 27th mtg., pp. 230-237.

The author reports a case of filaria loa in a 42-year-old American missionary from the Belgian Congo who knew he had been the host of filaria loa for eight years, and was at the time of observation apparently perfectly healthy. The patient described at length the migrations of the swelling about his body noting that the loa-loa was most painful when behind the eye where it would remain for sometimes an hour or more. As the worm is attracted by heat, a strong flash light was held close to the patient's eye, thus influencing the filaria to come to the surface. Landegger immediately made a conjunctival incision and the worm jumped into his open forceps. Lawrence G. Dunlap.

Löwenstein, Arnold. **Some relations between the diseases of the central nervous system and the eye.** Glasgow Medical Jour., 1940, v. 133, May, p. 157.

The author stresses the close biologic and anatomic relationship between the eye and brain. A résumé is given of many of the diseases affecting both organs, including tuberous sclerosis, Hippel's disease, Eales's disease, papilledema, papillitis, arachnoiditis, meningitis, multiple sclerosis, syphilis, and others. The author recommends irradiation for intrasellar tumors. If a radiogram shows any progressive change in the bones or if the visual field diminishes, an operation is essential. After discussing the various forms of treatment for tabetic optic atrophy, the author states that therapy is almost without effect. John C. Long.

Mikhailov, M. H. **Ocular changes in pappataci fever.** Viestnik Opht., 1940, v. 16, pt. 6, p. 440.

A review of the literature and an analysis of the ocular symptoms in 42 cases of sand-fly fever. The most typical symptoms are inflammation of the bulbar conjunctiva in the palpebral fissure, known as Pick's symptom; and Taussig's sign which consists of ocular pain on pressure, motion, or raising of the upper lid. Ray K. Daily.

18

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Berens, C., Williams, R. C., and Merrill, E. B. **Standards for outpatient ophthalmologic departments. Part 2, Standards for nursing service; Part 3, Standards for medical social service.** Amer. Jour. Ophth., 1940, v. 23, Dec., pp. 1352-1357.

Joannidès, Th. **Schools for trachomatous children.** Bull. Soc. Hellénique d'Opht., 1939, v. 8, Oct.-Dec., p. 306.

Primary schools have been established in certain Greek cities where trachomatous children may pursue their studies and at the same time receive treatment. The schools are under the supervision of eye specialists.

George A. Filmer.

Sydokevich, D. I. **Moulage in ophthalmology.** Viestnik Opht., 1940, v. 16, pt. 6, p. 497.

A description of the preparation of wax models of the eyeball.

Ray K. Daily.

19

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Löwenstein, Arnold. **Glass membranes in the eye. Part 1. Bowman's membrane, Descemet's membrane, and lens capsule.** Amer. Jour. Ophth., 1940,

v. 23, Nov., pp. 1229-1238. **Part 2. Lamina vitrea chorioideae.** The same, Dec., pp. 1340-1351.

Stone, L. S., and Ellison, F. S. **Exchange of eyes between adult hosts of Amblystoma punctatum and Triturus viridescens.** Proc. Soc. Exper. Biol. and Med., 1940, v. 45, Oct., p. 181.

An exchange of eyes was accomplished in 34 pairs of young adults of these two unrelated species of animals. The Triturus eye grafted on an Amblystoma promptly began to degenerate in all its tissues. On the other hand, when the Amblystoma eye was implanted in the Triturus host, a fair degree of success was accomplished. The cornea, iris, and pupil showed only moderate reaction. The retina showed an early degeneration but during the third week began to regenerate, this regeneration showing differentiation into specific layers during the second month. As early as the 41st day a completely regenerated optic nerve was seen extending from the graft to the chiasm of the new host. As late as 141 days after operation there were no signs that these eyes were undergoing degeneration. No tests for vision were made.

Morris Kaplan.

Verrier, L. **Comparative histophysiology of the fovea of vertebrates.** Bull. Soc. d'Opht. de Paris, 1939, Feb., p. 99.

The fovea exists in vertebrates fairly often. The study, of which the author gives a résumé, includes about 250 species, ranging from fish to mammals. He takes issue with the classic dictum that "the absence of rods and visual purple in the fovea is an accomplished fact of science." Direct examination of the human retina presents great difficulties, but the study of the visual cells and pigmentary epithelium of animals placed in the dark for varying lengths of time enables one to follow the distribution and localization of the visual purple.

All retinas which possess the purple in the peripheral regions also possess it in the fovea, as demonstrated by observation of the bony fish and the nocturnal birds. Binocular vision exists in all vertebrates and its extent depends upon the degree of lateral position of the eyes, but participation of the fovea in binocular vision is rare. It has been established that in case of both diurnal and nocturnal birds of prey the visual lines of the lateral foveae converge opposite to those of the central foveae. On the other hand only a central fovea exists in the reptiles studied by the author, including iguanas and chamelions. The fovea in the series of vertebrates studied by the author closely resembles the extrafoveal regions in: (1) the form of the visual cells; when the peripheral regions possess typical rods, these resemble closely the foveal cones. (2) The distribution of visual purple is quite comparable in the foveal and extrafoveal regions. The fovea does not seem to be easily distinguished from neighboring regions: (1) by the arrangement of the melanin of the pigment epithelium and by the addition of macular pigment; (2) by the disposition and richness in number of receptors and conductors.

Jerome B. Thomas.

NEWS ITEMS

News items should reach the editor by the twelfth of the month

Deaths

Dr. Samuel Lynn Wadley, Palmer, Texas, died November 4, 1940, aged 59 years.

Dr. Charles Elmore Trimble, Crestline, Ohio, died November 26, 1940, aged 77 years.

Dr. Charles Carlin Ayres, White Hall, Maryland, died December 9, 1940, aged 48 years.

Dr. Will Foster Fyke, Springfield, Tennessee, died November 27, 1940, aged 50 years.

Dr. Leon Clifford Wills, Philadelphia, Pennsylvania, died November 10, 1940, aged 58 years.

Dr. Clarence Curtin Bobb, Lykens, Pennsylvania, died November 16, 1940, aged 45 years.

Dr. Karl Sigismund Blackwell, Richmond, Virginia, died December 26, 1940, aged 61 years.

Dr. Louis Emmitt Brown, Akron, Ohio, died December 11, 1940, aged 59 years.

Dr. John Gerrit Huizinga, Holland, Michigan.

Miscellaneous

Graduate training in ophthalmology at New York University College of Medicine is being continued by Dr. Daniel B. Kirby, recently appointed professor of ophthalmology and director of the ophthalmological service at Bellevue Hospital, and Dr. Conrad Berens, associate professor of ophthalmology and director of the course.

The course consists of nine months of full-time training in the basic sciences in relation to ophthalmology as recommended by the American Board of Ophthalmology. It ordinarily precedes an ophthalmological residency in an approved hospital. Changes in the staff of the department have added a number of instructors in special subjects, notably, Dr. Samuel P. Oast, assistant visiting surgeon on the ophthalmological service of Bellevue Hospital and honorary surgeon of the New York Eye and Ear Infirmary; Dr. Frank C. Keil, ophthalmologist at the Seaside and City Hospitals; and Drs. Brittain F. Payne and Willis S. Knighton, surgeons at the New York Eye and Ear Infirmary. Dr. Alfred Cowan, professor of ophthalmologic optics at the Graduate School of Medicine in the University of Pennsylvania, is a guest lecturer.

Application blanks may be secured from the dean's office, New York University College of Medicine, 477 First Avenue, New York, New York.

The University of Minnesota held a continuation course in ophthalmology from January 20th to 25th at the Center for Continuation Study in Minneapolis. Seventy-three physicians from Illinois, Iowa, Kansas, Manitoba, Minnesota, Montana, North Dakota, Saskatchewan, South Dakota, Utah, Washington, and Wisconsin were in attendance. Dr. Frank E. Burch, professor of ophthalmology and head of the department, was in direct charge. Guest speakers included Dr. Thomas D. Allen, Chicago; Dr. Hugo L. Bair, Rochester, Minnesota; Dr. William L. Benedict, Rochester, Minnesota; Dr. Ramón Castroviejo, New York; Dr. Paul L. Cusick, Rochester, Minnesota; Dr. Avery D. Prangen, Rochester, Minnesota; Dr. C. Wilbur Rucker, Rochester, Minnesota; Dr. Albert D. Ruedemann, Cleveland, Ohio; Dr. Derrick Vail, Cincinnati; and Dr. Robert von der Heydt, Chicago.

The Manhattan Eye, Ear, and Throat Hospital, Department of Ophthalmology, New York, announces a schedule of evening lectures for graduate instruction of the resident staff. The lectures are given twice weekly, Mondays and Thursdays, from February 3d to March 27th, at seven o'clock. Hospital residents and graduate students are invited to attend. Further information may be secured by telephoning the hospital.

The program of the sixth annual Post-Graduate Institute of the Philadelphia County Medical Society, from March 31 to April 4, 1941, at the Bellevue-Stratford Hotel in Philadelphia, is of interest to ophthalmologists from a general point of view. It is rich in symposia on modern therapy.

Societies

On Friday, January 24, 1941, the Minnesota Academy of Ophthalmology and Otolaryngology held a dinner meeting at which over 100 members and guests were present. The speakers of the evening were: Dr. Derrick Vail, who discussed "The anatomy of the optic nerve and chiasm," and Dr. Ramón Castroviejo, who showed motion pictures on "Cataract surgery."

The Eye, Ear, Nose, and Throat Section of the Toledo Academy of Medicine announces the following officers for the year 1941-1942: Dr. J. E. Minns, chairman, and Dr. John D. Skow, secretary.

On Tuesday, February 11th, the Milwaukee Oto-Ophthalmic Society held its regular meeting. Dr. Sanford R. Gifford discussed "The use of vitamins in ophthalmology," and Dr. William Egan, of Milwaukee, spoke on "Ultra short-wave therapy, its use in diseases of the eye, ear, nose, and throat."

Personals

Dr. Edwin B. Dunphy of Boston wishes to call attention to an error in the News Items of the December issue. Dr. Dunphy was appointed clinical professor in ophthalmology at Harvard, succeeding Dr. Waite, who held a similar appointment. The last Williams professor of ophthalmology at Harvard was Dr. George Derby. Since his death no one has been appointed in his place.

The McReynolds Clinic of Dallas, Texas, announces the opening of its office in the Texas Bank Building, Main and Lamar Streets. Associated with Dr. John O. McReynolds and Dr. William E. Howard are Dr. Walter Spencer and Dr. Paul A. Richter. Dr. John L. Goforth is consultant in pathology and Dr. George S. McReynolds is consultant in bronchoscopy.

Dr. Eugene L. Bulson announces the removal of his office to the Wayne Pharmacal Building, 347 West Berry Street, Fort Wayne, Indiana.

On Monday, December 30, 1940, Mrs. Ruth Holznagle Rathbone of Birmingham, Michigan, was married to Dr. George Haeberle Stine.

In the News Items of the January issue of this Journal in a statement concerning Dr. Edmond E. Blaauw of Buffalo it was said that he was the first to bring the slitlamp into routine practice about 1912. This should be 1921.